# RELATIONS BETWEEN DIETS OF BREASTFEEDING WOMEN, SOCIOECONOMIC STATUS AND STRESS

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# CHAPTER I

## INTRODUCTION

The overall goal of this research is to examine the daily dietary intake of breastfeeding mothers and determine the extent to which psychological and socioeconomic factors affect the nutritional intake of breastfeeding mothers.  Women who choose to breastfeed are exposed to conflicting recommendations while breastfeeding, including recommendations to increase dietary intake, but they're also recommended to lose weight after pregnancy (Wolk, 1997). Breastfeeding women are recommended to increase their daily energy intake by 500 kilocalories per day (from their usual intake before pregnancy (Khan, 2006). Breastfeeding women are also encouraged to lose weight after pregnancy to maintain a healthy lifestyle (Wolk, 1997). According to the Subcommittee of Nutrition during Lactation Report, weight loss should occur at a rate of 1.3 – 1.6 pounds (0.59 – 0.73 kg) per month, but breastfeeding women should not restrict their energy intake to 1500 kilocalories (6276 kJ) or less per day (Nutrition During Lactation, 1997). This report also states that women who do not lose weight or women who are gaining weight after the first two months of lactation are recommended to decrease energy intake by 100 kilocalories (418.4 kJ) per day, in addition to increasing physical activity. Dietary energy intake may also affect protein intake, which is recommended to increase to 1.05 g/kg/day during breastfeeding ("Dietary Guidance", 2009). A moderate caloric restriction, around 1700 kilocalories per day, does not affect the mother's breast milk content, but a caloric restriction of less than 1700 kilocalories per day can affect the content of the mother's milk negatively

(Qian, Chen, Lu, Wu, & Zhu, 2010). Without clear dietary recommendations, breastfeeding could become just another stressor in the lives of women.

Stress levels of breastfeeding women do not significantly differ when compared with women who do not breastfeed, but non-breastfeeding women have a higher prevalence of negative moods (Groer, 2005). Socioeconomic status is an important factor in breastfeeding because research has shown women of a lower socioeconomic status have a decreased intake of important micronutrients and macronutrients, which is related to a decreased amount of nutrients in the mother's milk (Qian et al., 2010).

The hypothesis of this study is that dietary intake of breastfeeding women will differ based on psychological and socioeconomic status. The specific aims of the study are:

I. To describe the intake of breastfeeding women and compare it to the Dietary Recommended Intake.

II. Examine the effect of stress, age, income, and marital status, on the dietary intakes of calories, protein, calcium, zinc and iron.

   a. Protein needs increase during breastfeeding, but may be impacted by weight loss recommendations

   b. The maternal intake of zinc and iron are part of the larger study. Zinc is important in the normal development and growth of the fetus and is a factor in appropriate milk production during lactation (Fung, Ritchie, Woodhouse, Roehl, & King, 1997). If the mother's daily intake of iron is low, it will affect the concentration of iron in the mother's milk, which could cause iron deficiency or anemia in the infant (Pisacane et al., 1995).

The design of the study is cross-sectional and observational. The specific location of the study is Oklahoma and it is being conducted in a rural community setting. There are approximately 100 women who predominately breastfeed their three month old infants participating in the study. The materials that are used in this study are the Diet History

Questionnaire (DHQ), Parent Stress Index-short form (PSI), and a demographic form. The DHQ is a food frequency questionnaire (FFQ) that was developed by the Risk Factor Monitoring and Methods Branch of the National Cancer Institute and consists of 124 questions regarding the dietary intake, portion sizes and dietary supplementation of the subjects completing the questionnaire (“Diet history questionnaire”, 2009). The PSI short form is a questionnaire that contains 36 questions that relate to the mother’s stress, containing four different subscales, Parental Distress (PD), Parent-Child Dysfunctional Interaction (P-CDI), Difficult Child (DC), and Defensive Responding (DR) (PSI Short Form, 2010). The demographic form is used to gather data regarding the subject’s income, age, and marital status. The Oklahoma State University Institutional Review Board approved the study’s methods and procedures.

**Summary**

Nutrition during lactation is an area of nutrition that is comprised of conflicting recommendations. Breastfeeding women are recommended to increase their energy intake, but also are recommended to lose weight postpartum. Some studies have shown that moderate caloric restriction does not affect breast milk, but if a mother drops her energy intake too much this can cause a problem with breast milk production. Some factors that might impact the conflicting recommendations for breastfeeding mothers include socioeconomic status and stress. Socioeconomic status can affect the breastfeeding mother’s dietary intake. Mothers from a lower socioeconomic status have been shown to consume lower amounts of important micronutrients and macronutrients, but this group of women also has access to programs like Women Infant Children (WIC) and the Food Stamp Program. Stress in mothers that are breastfeeding has been shown to relate to the decrease in the duration of breastfeeding.

# CHAPTER II

## LITERATURE REVIEW

The period during which a new mother breastfeeds can be a stressful time in a woman's life. There are multiple dietary recommendations for breastfeeding women that could be affected negatively by stress and socioeconomic status. Overall, this literature review will discuss the dietary recommendations, weight loss recommendations, and the dietary intake of breastfeeding women, with a particular focus on protein, energy, iron, calcium and zinc intake. The literature review will concentrate on whether stress and socioeconomic status, specifically age, income and marital status, impact dietary intake during breastfeeding.

### Section 1 - Dietary Recommendations for Breastfeeding Women

There are multiple dietary guidelines or recommendations that a breastfeeding mother can follow to promote a proper or adequate dietary intake. The two most authoritative sources are the Dietary Reference Intakes (DRI) and the USDA Food Guide Pyramid. The DRI are a set of dietary recommendations that are suggested by the Institute of Medicine and consists of the recommended daily intake of macronutrients, minerals, and vitamins ("Dietary Guidance," 2009). The DRI consists of Estimated Average Requirements (EAR), the Recommended Dietary Allowance (RDA), Adequate Intake (AI), and Tolerable Upper Limit (UL). EAR is based on the dietary intake that is expected to satisfy the needs of 50% of the sample or age group, whereas the RDA is the daily intake of a nutrient that is recommended to meet the needs of 97 – 98% of the sample or population group. AI is used when no RDA has been set for a specific nutrient and is set to be adequate for the demographic sample. UL is set so the sample knows what the maximum amount of any specific nutrient is before there is an occurrence of any negative side effects

(“Dietary Guidance,” 2009). The Food Guide Pyramid is provided by the United States Department of Agriculture (USDA) and recommends the consumption of a variety of groups, including grains, milk, fruits, vegetables, and meat/beans. The Food Guide Pyramid recommendations are based on the person’s specific age, weight and physical activity, and also takes into account the specific samples, including pregnant or breastfeeding women (“mypramid.gov,” 2010). However, the Food Guide Pyramid does not provide a detailed diet for breastfeeding mothers. This study will be focused on the Dietary Reference Intakes when examining standards for dietary intake of this specific sample: breastfeeding women.

The specific dietary factors of interest in this study are calcium, iron, zinc, protein and energy intake. During lactation, protein needs increase (“Dietary Guidance,” 2009) and energy intake recommendations are conflicting for breastfeeding women (Wolk, 1997). Zinc is a factor in the appropriate production of breast milk (Fung et al., 1997) and iron intake is could affect the concentration of iron in the mother’s breast milk (Pisacane et al., 1995) According to the DRI, the proper amount of these nutrients for breastfeeding women include:

| **Nutrient** | **RDA for Breastfeeding women 19 – 50 years** |
|---|---|
| Protein | 71 g/d |
| Iron | 9 mg/d |
| Zinc | 12 mg/d |
| Calcium | 1,000 mg/d* |

(“Dietary Guidance”, 2009) *(Office of Dietary Supplements: Calcium, 2011).

The EAR values for breastfeeding women differs slightly when compared to the RDA values that are given. The EAR values for breastfeeding women, in regards to these specific nutrients include:

| Nutrient | EAR for Breastfeeding women 19-50 years |
|---|---|
| Protein | 60 g/d |
| Iron | 6.5 mg/d |
| Zinc | 10.4 mg/d |
| Calcium | 800 mg/d* |

(“Dietary Guidance,” 2009)   *(“Office of Dietary Supplements: Calcium,” 2011).

Estimated Energy Requirements (EER) is determined empirically. The equation for lactating women is in two different categories, 0 – 6 months postpartum and 7 – 12 months postpartum. The equations are:

| | |
|---|---|
| 0 – 6 months postpartum | EER = Nonpregnant EER[1] + 500 - 170 |
| 7 – 12 months postpartum | EER = Nonpregnant EER[1] + 400 - 0 |

[1](“Dietary Guidance,” 2009)

The EER equation provides for kilocalories per day and is Nonpregnant EER[1] + Milk Energy Output – Weight Loss. This equation would be the most rigorous way to calculate the energy needs of a lactating mother according to the DRI (“DRI,” 2006).

**Section 2 - Dietary Intake of Breastfeeding Women**

In 1984, Butte et al. completed a four-month longitudinal study that examined dietary intake, breast milk production, and body composition of 45 lactating women to examine relationships present amongst these variables. The subjects were considered healthy and exclusively breastfeeding for four months. The women were in the middle-upper socioeconomic level, with a mean age of 28 years. Each of the subjects completed a three-day dietary record, which included one weekend day, once during the four-month period. Samples of the mother’s breast milk were collected at the one, two, three and four month periods and tested for the volume

[1] Non-pregnant EER = 354 - (6.91 x age [y]) + PA x { (9.36 x weight [kg]) + (726 x height [m]) }

of milk produced during a 24-hour period and the monthly values of fat, calories and total nitrogen levels.

The study results showed that the maternal energy intake steadily decreased over the four-month lactation period. The mean energy intake for the mothers was 2,186±463 kcal/day or 37±10 kcal/kg/day. The range of energy intake from the three-day dietary analysis was 1,099 to 4,398 kcal/day. The average overall consumption of energy for the mothers from macronutrients was 37% from fat, 46% from carbohydrates and 17% from protein. Calcium intake for the mothers was between 94-102% of the recommended dietary allowances and iron consumption was 80% of the recommended intake for non-pregnant, non-lactating women. Approximately 94% of the mothers continued using their prenatal multivitamin-mineral supplements while lactating, and 33% took additional calcium supplements and 23% took additional iron supplements (Butte, Garza, Stuff, Smith, & Nichols, 1984).

A study completed in 2006 by Eileen Fowles and Lorraine Walker, collected data to identify if there was any correlation between the dietary quality of food being consumed and the post pregnancy weight retention in women. The study received 100 completed surveys from women, 18 years or older, that delivered singleton babies. A self-reported demographic form was used to look at the socioeconomic status of the women in the study. The dietary quality was assessed using the Food Guide Pyramid's five main food groups. The participants were asked to select the number of servings they had per day for each of the five food groups. Weight retention was collected for each subject by subtracting the pre-pregnancy weight from the postpartum weight. The women completed the Feelings and Thoughts about Weight Scale that measured their attitude towards their postpartum weight.

The subjects in the study ranged from 18-42 years of age, and were three to six months postpartum during the study. During the three to six months postpartum, 56 women in the study retained less than 3 kg of body weight and the other 44 women retained 3 kg of body weight or more. This study found a significant association between dietary quality of the subjects' diets and breastfeeding. Breastfeeding women were more likely to consume a well-balanced diet, according to the Food Guide Pyramid, when compared to non-breastfeeding women in the study. Breastfeeding women were more likely to consume, according to the Food Guide Pyramid, the recommended servings of bread, vegetables, fruit and milk. Also, there was no significant correlation between attitude toward postpartum weight or gestational weight gain and the postpartum dietary quality. The study did find that gestational weight gain and weight-related distress were significantly, positively related to weight retention postpartum (Fowles & Walker, 2006).

Olson completed a study in 2005 that examined the food choices women made during the transition to motherhood, and whether social location, income and breastfeeding affected these choices. The study observed three food choices, including drinking two or more cups of milk a day, eating three or more servings of fruit and vegetables per day, and eating breakfast every day. The study looked at five different points during the transition of motherhood, including pre-pregnancy, during pregnancy, and postpartum, to observe the food choices the mothers made. The study focused on whether the mothers would change their eating habits from pre-pregnancy to postpartum.

The women in the study received questionnaires in the mail and their medical records were reviewed. The questionnaires were mailed to the women during the first or second trimester of pregnancy, and six months, one year, and two years postpartum (Olson, 2005). According to the results, the women in the study had a dramatic decrease of fruits and vegetables consumption, milk consumption and breakfast intake from pregnancy to 6 months postpartum. When the consumption of fruits and vegetables and frequency of breakfast during the transition of motherhood was compared to the women's pre-pregnancy intake there was a significant increase of both factors. Overall the study found that mothers who breastfed up to one year postpartum were more likely to consume at least three servings of fruits and vegetables per day and to eat breakfast every day, but the breastfeeding women were not more likely to consume two or more servings of milk per day. There was a change in the consumption of fruits and vegetables during the transition to motherhood, but there was not a significant change in the consumption of dairy (Olson, 2005).

Women who are breastfeeding have a more balanced diet that enhances their overall dietary quality, when compared to non-breastfeeding women (Fowles & Walker, 2006; Butte, Garza, Stuff, Brian Smith, & Nichols, 1984). Breastfeeding women are also more likely to consume fruits and vegetables and breakfast daily (Olson, 2005). Dietary quality was found to be positively associated with dietary quality in breastfeeding women (Fowles & Walker, 2006), which implies breastfeeding women are consuming a diet that is nutrient rich and providing an adequate amount of the essential micro and macronutrients.

**Section 3 - Weight Loss and Weight Gain Recommendations for Breastfeeding Women**

The retention of postpartum weight may lead to an increase in the incidence of obesity in the individual (Mohammad, Sunehag, & Haymond, 2009). Mohammad et al. examined two different diets that were assigned to women after pregnancy and during lactation to see if there were any adverse effects on the mother's production of breast milk. There were a total of seven healthy, lactating mothers of different races, in this study. Each woman was studied for eight days, on two different occasions. The study was conducted at home for four days and at a central location the other four days of the study. Diet one was a high fat, high carbohydrate diet, which contained 60% carbohydrates, 25% fat and 15% protein by total kilocalories, and diet two was a low carbohydrate, high fat diet, consisting of 30% carbohydrates, 15% protein and 55% fat by total kilocalories. One significant finding of the study was the high fat, low carbohydrate diet increased the fat content in the breast milk by approximately 13 percent, which caused the milk to be higher in caloric density (Mohammad, Sunehag, & Haymond, 2009). The high fat content of the milk causes an increase in calorie intake from fat for the infant, and could potentially increase the chance of weight gain and obesity.

Olson, Strawderman, Hinton and Pearson (2003) conducted a study that examined the importance of gestational weight gain, energy intake pre and postpartum, breastfeeding, and postpartum exercise and its affect on the weight gain or loss between early pregnancy and one year postpartum. The study had a total of 540 healthy women, over the age of 18 years, who gave birth to singleton babies. The study followed these women from early pregnancy until one year postpartum. The women in the study were recruited from a primary care clinic system that served a ten county area in upstate New York. The sample of women in the study were primarily Caucasian, rural and socioeconomically diverse. The women in the study were mailed questionnaires and food frequency questionnaires during the first and second trimesters, six months postpartum and one year postpartum. Data were also obtained from the women's obstetrical records. The women's weight and height were retrieved at the antenatal visits and at one year postpartum.

The outcome variable that was of specific interest for this study was the weight retention in kilograms between early pregnancy and one year postpartum (Olson, Strawderman, Hinton, & Pearson, 2003). The weight categories that were used in the study were from the Institute of Medicine, which classified the women as underweight, normal, overweight or obese according to the BMI index. Gestational weight gain was also determined for each of the participants in the study. The amount of energy that was expended each week was calculated from the physical activity questionnaire. Breastfeeding status for each of the mothers was collected at the sixth week obstetrical visit and at six months and one year postpartum. A scale was designed to determine the exclusiveness of the mother's breastfeeding status. Some cofounding variables of the study included age, education level, smoking status, annual income level, pre-pregnancy BMI and marital status.

At the six-week postpartum visit, approximately 81% of the women in the study had initiated breastfeeding, 66% were still breastfeeding at 6 weeks, and 48% of the women were breastfeeding at six months postpartum. During the second six months postpartum, 49.4% of the participants decreased their food intake and 13% decreased their food intake "a lot". At the one year postpartum visit, 41.7% of the women in the study had a body weight that was equal to or less than their body weight early on in their pregnancy, 32.8% retained 0 – 4.55 kg postpartum and 25.6% were 4.55 kg heavier or more at one year postpartum when compared to their early pregnancy weight. At one year postpartum, 25% of the women were breastfeeding their infants. The mean energy intake change during the second six months postpartum was -318.1±129.8 kJ/day. According to the study, women who exercised often, ate less postpartum and were breastfeeding at one year postpartum had a significant difference in weight retention when compared to the other women in the study. The findings in this study showed that breastfeeding up to one year postpartum may help women with weight retention; it is not considered a solely significant avenue for losing weight (Olson et al., 2003).

Butte et al. completed a study in 1984 that examined the effect of maternal diet and its relation to lactation performance[2]. In regards to weight the study found there was a steady weight decline during the 4 months postpartum and the average weight loss for the mothers was 48 g/day, with a mean weight loss of 3.8 kg during the first month postpartum.

A factor that can help women lose weight postpartum is breastfeeding. Women who breastfeed had a steady weight decline postpartum, and up to one year postpartum, breastfeeding women had a decline in weight retention (Butte et al. 1984; Olson et al., 2003). Exercising and decreasing dietary intake postpartum are also factors that can help a mother lose weight after pregnancy.

**Section 4 - Socioeconomic Status and Dietary Intake in Breastfeeding Women**

A study completed in Shanghai, China by Qian, Chen, Lu, Wu, and Zhu, (2010) examined the socioeconomic status of women and how the level of socioeconomic status affects dietary intake during breastfeeding. The study examined three different urban areas and one

[2] Refer to section 2 for background information on study: (Butte et al., 1984)

suburban area of Shanghai, China. The suburban area of Shanghai had a lower socioeconomic status when compared to the urban areas of Shanghai. The specific socioeconomic indices contributing to socioeconomic status were occupation, education level and income. They examined the macronutrients and micronutrients, including protein, lipids, carbohydrates, energy intake, manganese (Mn), sodium (Na), chloride (Cl), calcium (Ca), iron (Fe), copper (Cu), zinc (Zn), and phosphorus (P), for the mothers in both the urban and suburban areas of Shanghai, China.

The sample for this study was 120 healthy, lactating women between the ages of 22 and 36 years who were recruited through hospitals (Qian et al., 2010). Breast milk samples were obtained from the mother approximately 8 – 10 days postpartum and they were obtained by manual expression. A 24-hour recall and dietary questionnaires were administered to obtain the dietary intake of the mothers. The mothers filled out the 24-hour recall the day before the breast milk sample was collected. The suburban area had a significantly lower socioeconomic status, when compared to the urban areas. The mothers in the suburban area were younger and had higher unemployment levels. Also, the level of education for the suburban area was at the elementary school level and the subjects in the suburban area had a lower income status, when compared to the urban areas. The weight gain of the infants from the suburban area was significantly lower than the infants in the urban area at six months of age.

The women in the suburban area of the study had a significantly lower dietary intake of protein, lipids, Na, K, P, and Ca when compared to the urban area of women in the study. Although there was a significant difference in the intake of specific nutrients for the women in the lower socioeconomic bracket, there was not a significant difference between the two groups in terms of energy intake. The concentration of micronutrients and macronutrients in the breast milk of the women in the study varied between the two groups. The women from the suburban area, or the lower socioeconomic level of women, had a lower concentration of all micronutrients and macronutrients in breast milk, except for carbohydrates, when compared to the women in the urban areas of the study. Specifically, the dietary intake of Fe ($p = 0.031$) and Zn ($p = <0.001$) were both significantly lower for the suburban group of women (Qian et al., 2010).

An interesting finding of the study was that both women from urban and suburban areas in Shanghai, China had a low intake in calcium. The postpartum milk samples showed a significantly lower amount of zinc and iron in suburban mothers' breast milk. The overall finding in this study was dietary intake might be dependent on the socioeconomic status of the women. The women in the study, considered in the lower level of socioeconomic status, had a decreased intake of important micronutrients and macronutrients, and there was also a decrease in the micronutrients and macronutrients of the mother's breast milk in the women of lower socioeconomic status (Qian et al., 2010).

In California, a study examined socioeconomic status and its affect on breastfeeding. The study was a large, randomized sample of women who were ethnically diverse (Heck, Braveman, Cubbin, Chavez, & Kiely, 2006). The study hypothesized that maternal variables would be stronger than paternal variables in relation to breastfeeding, and that maternal education would have a large influence on the initiation of breastfeeding, when compared to income or occupation. There were a total of 10,316 infants included in this study. The data for this study were retrieved from the California Maternal and Infant Health Assessment (MIHA) that asked questions regarding breastfeeding. Information regarding the mother and father's education level, occupation, method of delivery, maternal age and birth-weight were retrieved from the infant's birth certificates. The demographics that were observed in this study included marital status, maternal age, country of birth, and whether the mother was enrolled in WIC during or after the pregnancy.

The results of the study showed that women who had a lower level of education and a lower income were less likely to ever breastfeed. Also, for both the mother and father, a lower level of occupational status and unemployment was associated with not breastfeeding their child. Women in the study who had three or more children were less likely to breastfeed when compared to lower-parity women. Non-obese women, nonsmokers and alcohol drinkers were more likely to breastfeed their infant. Women with a lower maternal age, between 15 to 18 years and single, unmarried women were less likely to breastfeed. Also, women who had a professional or executive occupation were less likely to breastfeed. The results of this study showed that maternal education was a significant predictor of the initiation of breastfeeding. Overall, the study found that paternal and maternal education levels were both more important factors in the initiation of breastfeeding, when compared to income and occupation (Heck et al., 2006).

The American Dietetic Association published a study by George, Hannss-Nuss, Milani, and Freeland-Graves in 2005 that examined the postpartum dietary behaviors of low-income women. There were 149 ethnically diverse women who qualified for Medicaid. The women received a food frequency questionnaire (FFQ) to examine their dietary intake for the first six months postpartum. The FFQ was self-administered and examined for completeness by study staff. The sociodemographic information was collected by self-administered questionnaires that were filled out at the hospital. Lactating women were categorized as exclusively breastfeeding or both breastfeeding and bottle-feeding at 6 months postpartum. There were 18.1% of the women (n=27) in the study that were in the lactating category. The women in the study had to consume at least 830 kilocalories per day, but no more than 4,830 kilocalories per day to participate in the study.

The study results found that the low-income women did not meet the dietary guidelines for vegetables, fat and dairy, according to the Food Guide Pyramid. Lactating women in the study reported having a higher intake of fruits and vegetables, and lower intake of fat in their diet when compared to the non-lactating women. According to the study, a reason for food choices that are high in fat and kilocalories might be due to the socioeconomic status of the women. Some speculations for the high fat intake of low-income women included the low cost of energy dense and low nutrient content foods ,nutrition knowledge, availability, and “social marketing campaigns" (George et al., 2005). The study saw an increase in milk and fruit juice consumption, which could be contributed to the distribution of flyers and vouchers from WIC. The study found, overall, that women who breastfed their children up to 6 months postpartum had more positive dietary behaviors, when compared to non-lactating women. Also, the study showed that women who were lactating had a lower level of energy intake, when compared to non-lactating women in the study (George et al., 2005).

Olson (2005) completed a study that focused on the dietary intake of mothers during the transition to motherhood[3]. Olson examined whether social location (including number of births, parity and socioeconomic status), income and breastfeeding affected these choices. The study results, in regards to social location and income, found the low-income women in the study, when compared to the high-income women, had a significantly lower consumption of 3 or more servings of fruits and vegetables, and eating breakfast each day. The low-income women were less likely to engage in healthy, positive food choices, when compared to the high-income women. During pregnancy and at 2 years postpartum, the low-income and high-income women only differed significantly in the consumption of fruits and vegetables (Olson, 2005)

A study completed in 2005 examined low-income women and their compliance with the Dietary Guidelines in late postpartum, and observed whether psychosocial variables had an impact on the compliance with the Dietary Guidelines (George, Milani, Hanss-Nuss, & Freeland-Graves, 2005). There were a total of 146 low-income, ethnically diverse women in this study. The women filled out a food frequency questionnaire (FFQ), after being give written and verbal instructions from a nurse or nutritionist. The dietary behavior of the participants was compared to the Dietary Guideline Index. The psychosocial questionnaires were self-administered and were received via the mail.

According to the study, the low-income women generally did not comply with the Dietary Guidelines (George, Milani, Hanss-Nuss, & Freeland-Graves, 2005). The

[3] Refer to section 2 for background information on study: (Olson, 2005)

recommendations for meat, fish poultry, dry beans, eggs and nuts were not met by over 60% of the participants in the study, and the intake of fruit, grains, vegetable and dairy was low according to the dietary guidelines. Participants following the Dietary Guidelines had a decrease in stress, depressive symptoms, neglect of self-care, and any perceived barriers the women might have towards weight loss. In this study, the majority of women retained their pregnancy weight gain one year postpartum and the mean BMI was 26±0.5 (pre-pregnancy) and increased to 28.9±0.6 (1 year postpartum). Also, the women in the study had a high intake of total fat, saturated fat, and cholesterol. According to the study, some reasons for poor dietary intake could include the high cost of more nutritious foods, lack of knowledge about nutritional foods, lack of cooking skills, and insufficient shopping facilities (George, Milani, Hanss-Nuss, & Freeland-Graves, 2005).

Women who are considered of lower socioeconomic status are not meeting dietary recommendations according to the Food Guide Pyramid, or consuming enough micro and macronutrients (George, Milani, Hanss-Nuss, & Freeland-Graves, 2005; George, Hannss-Nuss, Milani, & Freeland-Graves, 2005; Qian, Chen, Lu, Wu, & Zhu, 2010). Women of lower socioeconomic status are consuming a higher fat, higher caloric diet that can affect the breast milk content that is being fed to the baby (George, Hannss-Nuss, Milani, Freeland-Graves, 2005; Mohammad, Sunehag, & Haymond, 2009).

**Section 5 - Stress and Lactating Women**

There have been numerous studies that show maternal psychological distress is related to the mother's perception that their child is difficult (Thome, Alder, & Ramel, 2004). A study conducted in Finland showed that mothers with depressive symptoms often had a decrease in breastfeeding duration when compared to mothers that did not experience depressive symptoms (Tammentie Tarkka, Astedt-Kurki, & Paavilainen, 2002). Slykerman et al. found that mothers with high levels of emotional stress had children that were more likely to have developmental delays (Slykerman, Thompson, Clark, Becroft, & Robinson, 2007).

Thome et al. examined the relationship between parenting stress in women who were exclusively breastfeeding their children during the first two and three months postpartum. (Thome, Alder, & Ramel, 2004). There were 1000 women recruited for this study. Two months after the women delivered their babies, questionnaires were mailed out and approximately 734 women answered the questionnaires completely. The Parenting Stress Index (PSI), short form, was used to examine the mother's stress levels and a self-reported questionnaire was used to collect information about the infant's feeding methods (Thome et al., 2004).

The results of the study showed psychosocial factors and demographic factors affect the likelihood of a mother exclusively breastfeeding her infant (Thome, Alder, & Ramel, 2004). Thome et al. found that the higher the incidence of depressive symptoms and stress, the lower the chance of the mother exclusively breastfeeding her infant. The main factors that negatively impacted the chance of the mother exclusively breastfeeding her child are low education level, birthing twins, marital status, and incidence of depressive symptoms. Although this study did not examine stress and how it relates to the dietary intake of a breastfeeding mother, it did demonstrate an increase in depressive symptoms was related to a decreased desire to breastfeed (Thome et al., 2004).

A study conducted by Mezzacappa, Guethlein, and Bagiella focused on the stress levels of breastfeeding women. An online survey was made available to participants in the study via the Internet. The study included 168 breastfeeding women, and 65 mothers who had weaned their children from breastfeeding between 4 and 208 weeks postpartum. The Perceived Stress Scale, or PSS, was used in this study to determine the women's levels of stress. According to the study, the women who were currently breastfeeding had lower levels of stress when compared to the mothers who had weaned their children from breastfeeding (Mezzacappa, Guethlein, & Bagiella, 2000).

Mezzacappa, Guethlein, and Katkin conducted a second study that further extended their findings from 2000. The study compared the perceived stress of mothers who were currently breastfeeding (n=561) and mothers who had breastfed in the past (n=462) (Mezzacappa, Guethlein, & Katkin, 2002). Some important factors that were included in the assessment of breastfeeding status were the frequency of nursing, the cumulative amount of breastfeeding throughout the mother's lifetime, and the duration since the last nursing. The PSS was used in this study to determine the stress of the mother. The results of the study showed that breastfeeding women had a lower level of perceived stress, when compared to the non-breastfeeding women (Mezzacappa et al., 2002).

Mezzacappa and Katkin conducted a third study in 2002 that observed the differences in stress levels between breastfeeding mothers, exclusive and non-exclusive, (n=28) and mothers who only bottle-fed their infants, (n=27) (Mezzzacappa, Katkin, 2002). The mothers in the study would visit the laboratory once to breast-feed or once to bottle-feed their infants. The results showed that women who were breastfeeding their children had a lower level of negative mood, both before and after feeding. Also, the breastfeeding group of mothers reported having a lower level of stress, when compared to the group of mothers who did not breastfeed their children. Mothers who bottle-fed their children had a lower incidence of positive mood, and the mother's who breastfed their children had a lower incidence of negative mood. The children's age, mother's work status and number of children were controlled during this study (Mezzzacappa & Katkin, 2002).

A study completed in 2005 observed the differences in stress levels and mood between exclusive breast-feeders (n=84), formula-feeders (n=99) and a control group (n=33) of healthy, non-postpartum women between 4 and 6 weeks postpartum (Groer, 2005). The mothers fed their children normally and within one to three hours afterwards a blood sample was collected. The Perceived Stress Scale, Tennessee Postpartum Scale, Profile of Mood States, and Inventory of Small Life Events were used to help determine the mothers' moods and stress levels. The study's sample showed that mothers who breastfeed were older, smoked less, more likely to be married, and had a higher income, when compared to the formula-feeders. There was no difference in postpartum stress levels when comparing the breast-feeders to the formula-feeders. The significant difference between the two groups was their mood scores. The breast-feeders had significantly lower scores in the categories of depression, anger and anxiety, when compared to the formula-feeders. There were three demographics, including age, marital status, and income, that were different among the breast-feeders and formula-feeders. Marital status and age were not related to the mother's mood, but lower income was a factor related to depression and anxiety in the mothers. Overall, the study found that women who exclusively breastfeed their child have a more positive mood and have less perceived stress, but that income can have a powerful influence on these specific variables (Groer, 2005).

If a woman is experiencing higher stress and a higher incidence of depressive symptoms, she could be less likely to exclusively breastfeed. Women who were breastfeeding had lower levels of stress than women who decided to wean their children off breastfeeding or didn't breastfeed their child (Mezzacappa, Guethlein, & Bagiella, 2000; Mezzacappa, Guethlein, & Katkin, 2002; Mezzacappa & Katkin, 2002). Another study found that stress levels didn't vary in women who were breastfeeding, formula-feeding, and a control group, but that mood levels were different. Breastfeeding women had a lower level of depressive feelings, anger and anxiety. Although there are conflicting results in breastfeeding women and stress, there seems to be a pattern in the decrease of depressive symptoms in breastfeeding mothers (Groer, 2005; Thome, Alder, & Ramel, 2004).

When an individual is stressed, numerous hormones (e.g., cortisol) are released by the hypothalamic-pituitary-adrenal (HPA) axis, and the sympathetic-adrenomedullary (SAM) response (e.g., norepinephrine and epinephrine) (Mezzacappa, 2004). Symptoms of stress include an increase in blood pressure and heart rate. During lactation in rats, both HPA and SAM signaling are decreased or inhibited when stress is present (Lightman, 1992). Oxytocin is a hormone that is involved in breastfeeding. The function of oxytocin is to increase the stimulation of uterine contractions and also stimulates the release of milk from the mammary glands (Mezzacappa, 2002). When there is an increase in the level of oxytocin during breastfeeding, there is a decrease in negative mood for the mother (Uvnas-Moberg, 1993).

**Section 6 - Energy and Protein Needs During Lactation**

Energy needs during lactation can vary based on whether the mother is exclusively breastfeeding or not (Dewey, 1997). Women who are exclusively breastfeeding have an average energy cost of 595 kilocalories (2490 kJ)/day during the first 2 months of lactation and an average of 670 kilocalories (2803 kJ)/day during the third through eighth months of lactation. The average needs of energy for exclusively breastfeeding women can range between 2500 to 3300 kilocalories (10,460 – 13,807 kJ) per day. If a woman is consuming 2500 kilocalories (10,460 kJ)/day this is the lower end of the calorie recommendation that allows for a weight loss of 500 grams per month. If a mother is consuming less than 2500 kilocalories (10,460 kJ)/day then she is most likely not exclusively breastfeeding and is losing weight at a more rapid pace when compared to 500 grams per month (Dewey, 1997). The protein needs of breastfeeding mothers are 71 grams per day ("Dietary Guidance," 2009). The level of protein in the mother's milk depends on what stage of lactation she is in, with values declining in correlation with the length of lactation (Dewey, 1997).

The DARLING (Davis Area Research on Lactation, Infant Nutrition and Growth) study collected milk samples during the first 12 months of lactation from a large sample of well-nourished women (Dewey, Heinig, Nommsen, & Lonnerdal, 1991). Nommsen et al. completed a study in 1991 that examined the factors that could be associated with the nutrients in breast milk at 3, 6, 9 and 12 months of lactation and used the sample set from the DARLING study (Nommsen, Lovelady, Heinig, Lonnerdal, & Dewey, 1990). There were a total of 73 breast-feeding participants at three months, 60 at six months, 50 at nine months and 46 at twelve months. The mothers and infants in the study were all healthy and did not plan to give their child solid foods before four months or to feed their child more than 120 mL per day of formula or any other type of milk. The participants were visited monthly for eighteen months to retrieve the mother's height and weight. The babies were weighed before and after nursing for four consecutive days at the three, six, nine and twelve month time points. The milk samples were collected for each of the feedings that occurred over a 24-hour time frame. There were 32 participants that completed a record of their dietary intake over a 3-day period during the three, six, nine, or twelve-month periods.

The results of the study found specific variables that were significant in regards to milk concentration, including percentage of Ideal Body Weight (IBW), frequency of nursing, the percentage of milk that was pumped, the reoccurrence of menstruation, and parity. The women in the study who lost more weight postpartum had a lower concentration of protein in the milk. The concentration of protein in the milk was positively correlated with the number of feedings that occurred in a 24-hour time period at 6 months. A significant finding was the high correlation between energy density and lipid concentration. At the six, nine, and twelve-month collections, the concentration of lipid in the milk was influenced by maternal fat, or %IBW. At nine months, the volume and % IBW was significantly correlated with the concentration of protein in the breast milk. The mean energy intake of the participants was 2340 kilocalories (9791 kJ) per day, with 17% coming from protein, 32% from fat, and 50% from carbohydrates. There was no correlation found between dietary intake and the milk concentration of protein, but the concentration of lipid and energy in the breast milk was influenced by the maternal protein intake (Nommsen, et al., 1991).

Butte et al. (1984) found that the intake of energy was significantly correlated with the production of milk during the second and third months postpartum in their breastfeeding sample[4]. The study found that approximately 13% of the variability in the milk production was explained by the energy intake of the mother. Protein, carbohydrates and fat had no affect on the quantity

[4] Refer to section 2 for background information on study: (Butte et al., 1984)

or quality of the mother's breast milk. The study found that 2300 kilocalories (9623 kJ)/day would be required for adequate milk production among this sample of women. Also, the women in the study had approximately 1730 kilocalories (7238 kJ)/day for the maintenance of daily activities, not accounting for the energy requirements of lactation. So, the women in this study met the required energy needs, consuming 2186 kilocalories (9146 kJ)/day, to support adequate lactation and gradual weight loss (Butte et al., 1984).

Mohammad completed a study in 2009 that looked at different diets postpartum. A significant finding in the study was that moderate caloric restriction for the mother did not affect the production of breast milk or the energy content of the milk. Moderate caloric restriction in this study was considered 1785 ± 22 kilocalories (7468±92 kJ) per day (Mohammad, Sunehag, & Haymond, 2009).

The calorie recommendations for breastfeeding women vary between 1700 kilocalories (7112 kJ) to 3500 kilocalories (14,644 kJ) per day. If a woman is losing weight rapidly postpartum it can affect the content of her breast milk (Dewey, Heinig, Nommsen, & Lonnerdal, 1991; Butte et al., 1984). Moderate caloric restriction was not shown to affect the mother's milk production, but restriction less than 1700 kilocalories (7112 kJ) per day will affect the mother's milk content and production negatively (Mohammad et al., 2009; Qian et al., 2010).

**Section 7 - Calcium Intake in Breastfeeding Women**

The consumption of calcium during lactation is important because if the stores of calcium in the body deplete, then there could be adverse effects on bone health (Thomas & Weisman, 2005). During pregnancy and lactation, approximately 210 mg/d is transferred to the child during breastfeeding ("Institute of Medicine," 2010). Recently, the recommended intake of calcium has been changed from being an AI value, to becoming an RDA and EAR value. The new RDA value for calcium, in breastfeeding women between 19-50 years, is 1,000 mg/day and the EAR value is 800 mg/day ("Dietary Guidance", 2010). An increase in dietary calcium intake during breastfeeding is not necessarily needed, due to evidence that shows the excess intake of calcium during breastfeeding is not related to the transfer of calcium to the mother's breast milk (Prentice, 2000). Evidence from Prentice's previous studies showed that the body mobilizes a sufficient amount of calcium for proper fetal growth and the production of breast milk, without increasing the dietary intake of calcium (Prentice, 2000)

When a mother breastfeeds her infant for longer than three to six months, she will lose more calcium via breast milk than she lost in the transfer to the fetus during her entire pregnancy (Prentice, 2000). The amount of calcium that is transferred from mother to child via breast milk depends on the milk concentration and/or the amount of milk that is produced by the mother. The region that the mother resides in also influences the concentration of calcium in the breast milk, and in the United States women have approximately 300 mg/liter of calcium in their breast milk. A hypothesis that is being examined by studies currently is whether the mother's dietary intake during pregnancy has an effect on the milk concentration of calcium.

A study completed by Prentice in 2000 found that there is a significant reduction in maternal bone mineral density during the first three to six months of breastfeeding. The area of major loss of bone mineral density is the spine and hip, with an average decrease of 3 – 5% during the first three to six months of breastfeeding. A study completed by Laskey and Prentice in 1999 found that the rates of bone loss increase the longer a woman breastfeeds. According to Prentice, the levels of calcium that are lost during lactation may increase the woman's risk of osteoporosis and this is especially true if the woman has a poor dietary intake of calcium before pregnancy and lactation (Prentice, 2000).

In 1999 Polatti et al. examined the bone mineral changes in women who breastfed (n=234) for 6 months, with one month of weaning, and then followed them for twelve months after lactation had stopped. They also followed a group of non-lactating women (n=153) for eighteen months, with the same timeline as the lactating women. The participants in the lactating group were separated based on three factors:

1. the consumption of calcium supplementation, consuming one gram per day (n=121)

2. Or not consuming calcium supplementation (n=113)

3. Based on whether their menstrual cycle started before or after five months postpartum.

Dietary intake was not restricted for any of the groups in the study.

The results of the study showed a significant progressive decrease in bone mineral density in the lactating women during the first six months of lactation, but there was a recovery of bone mass at eighteen months postpartum that was higher than the initial baseline. The breastfeeding women who had started their menstrual cycles during the first five months postpartum had a greater decrease in bone, but they gained a significantly greater amount of bone mass after their cycle began. The supplementation of calcium for lactating women in the study had no significant effect on the decrease of bone mass when the two groups were compared. The non-lactating group in the study had an increase in bone mineral density when compared to the baseline levels. The study's main limitation was the lack of account for the dietary intake of calcium for all women in the study (Polatti et al. 1999).

The dietary requirements for calcium recently changed from being an Adequate Intake nutrient to being classified as an Estimated Average Requirements (EAR) and Recommended Dietary Allowance (RDA) nutrient, which lowered the recommended intake to 800 mg (EAR) and 1,000 mg (RDA) ("Dietary Guidance," 2010). Calcium consumption is important to help restore depleted stores of calcium, which will help prevent any adverse effects that might occur for the mother's bone health (Thomas & Weisman, 2005; Prentice, 2000). There is a large amount of calcium that is transferred to the infant via breast milk (Institute of Medicine, 2010). Since there is a large amount of calcium that is lost via breast milk, it is important for a breastfeeding mother to consume enough calcium to help prevent osteoporosis and bone loss (Polatti et al., 1999; Prentice, 2000; "Institute of Medicine," 2010).

**Section 8 - Iron and Lactation**

A study conducted in 2004 examined the concentration of zinc, copper, and iron in breast milk (Domellof, Lonnerdal, Dewey, Cohen, & Hernell, 2004). The study was conducted at two different sites, one in Honduras and one in Sweden. The inclusion criteria for the sample (n=191) was birth weight greater than 2,500 grams, maternal age over 16 years, infant exclusively breastfed at four months, gestational age greater than 37 weeks and the infant being free of any chronic illnesses. Between six and nine months postpartum, the mother was allowed to give the infant food or fluids besides breast milk. Blood and milk samples were obtained from the mother at nine months postpartum. The Honduras sample completed a biweekly 24-hour dietary recall and a FFQ, between 6 and 9 months postpartum. The Swedish sample completed a monthly 5-day food diary during 6 and 9 months postpartum.

The results of the study showed a sample difference between the two sites. The Honduran women were younger, had a higher parity rate, lower weights and heights, and lower birth lengths and weights for their infants. The Honduran mothers in the sample had lower levels of hemoglobin and ferritin. Also, the Honduran mothers had lower levels of iron in their breast milk, when compared to the Swedish mothers, which could be caused by the higher milk volume. There was a positive correlation between milk iron concentration and food energy intake in the Honduran women ($p$ = .002). The study found, overall, there was no correlation between milk iron and the iron-status variables, including hemoglobin, ferritin, ZPP and TfR (Domellof et al., 2004).

When the mother's dietary intake of iron is low, this may affect the concentration of iron in the breast milk, which can cause iron deficiency or anemia in the infant (Pisacane et al., 1995). Breastfed infants can have a higher occurrence of anemia and iron deficiency, depending on the mother's intake of iron, when compared to formula fed infants because there is enough iron in formula. If the mother consumes a diet that has the recommended amount of iron and the infants are supplemented with an iron supplement, it should not cause anemia or iron deficiency in the infant (Park et al., 2007; Calvo, 1992).

**Section 9 - Zinc Intake During Lactation**

Lactation can cause a threat to the maternal status of zinc, especially in a group of women who have a low dietary intake of zinc (Krebs, 1998). There are two benefits of maternal zinc supplementation that can occur for the mother and they include better maternal zinc status and the improvement of lactation performance (Krebs, 1998). Krebs et al. completed a study in 1995 that examined the effects of zinc dietary intake in mothers and how it affected milk zinc concentrations during the first seven months of lactation (Krebs, Reidinger, Hartley, Robertson, & Hambidge, 1995). The study was a randomized, prospective, double-blind, controlled supplementation study. The mothers (n=52) in the study were exclusively breastfeeding through 5 months postpartum and continuing breastfeeding through seven months postpartum. There was a group of women (n=19) in the study that were enrolled twenty weeks gestational or earlier and there was a control group (n=18) of non-lactating, postpartum women. There were women in each group that received either a zinc supplement of 15 mg or a placebo pill. The supplement was to be taken half an hour before or three hours after the women's evening meal. Each participant in the study also consumed prenatal vitamins, without zinc, in the morning. Milk samples were collected from the subjects and a three-day baby-weigh periods were designated at two weeks, three months, five months and seven months postpartum. The babies were weighed before and after each feeding during the three-day period. The women each completed a three-day dietary record postpartum.

The results of the study found that the dietary intake of the zinc supplement (ZS) group was 11.6±3.6 mg/day, and with the supplement their intake was 25.7±3.9 mg/day. The non-zinc supplement (NZS) group had an intake of 13.0±3.4 mg/day. For the lactating subjects in the study, there was a significant decline of energy intake overall during the first seven months postpartum when compared to the non-lactating group (Krebs, Reidinger, Hartley, Robertson, & Hambidge, 1995). According to the DRI, the recommended intake of zinc for breastfeeding women between the ages of 18-50 years is 12 mg/day ("Dietary Guidance," 2009). Krebs et al. found that the NZS group of women, who were not given the supplement during gestation, had a significant decline in their zinc plasma concentration from twenty weeks to thirty-six weeks, whereas the ZS group had no change in their gestational levels of zinc (Krebs, Reidinger, Hartley, Robertson, & Hambidge, 1995). There was a significant decline in plasma zinc levels in the NZS group at all time points between twenty weeks and thirty-six weeks of lactation. Also, the study found that the ZS group that started the supplement during gestation had higher concentrations of zinc throughout the entire seven months of lactation, but the levels of zinc were the highest during the first three months of lactation. All of the lactating subjects in this study had a significant decline of their milk zinc concentrations, and the largest decline occurred during the first three months of lactation.

A longitudinal study completed by Moser-Veillon and Reynolds in 1990, examined whether the intake of zinc and pyridoxine would affect the mother's breast milk concentration of these two nutrients. There were a total of 40 women in the study and they were put into four random groups that were given different levels of zinc (0 or 25 mg/day) and pyridoxine. The study lasted over a nine month period and samples of the mother's breast milk, fasting blood samples and three-day dietary records were obtained at week one and two, then at one, three, six, and nine months postpartum. There was an increase in the mother's plasma zinc during the first and twelfth week postpartum, but then the levels plateau for both groups, the group consuming 0 mg of zinc and the group consuming 25 mg of supplemental zinc. The study results showed that overall there was no significant effect on the plasma concentration, erythrocyte concentration or milk concentration of zinc for the groups consuming 0 or 25 mg/day of zinc. These results suggest that the dietary intake of zinc in the mother's diet does not affect the concentration of zinc in the mother's milk. The study did find that iron interfered with the absorption of zinc (Moser-Veillon & Reynolds, 1990).

Zinc is an essential nutrient needed for the normal development and growth of the fetus and for proper milk production during lactation (Fung, Ritchie, Woodhouse, Roehl, & King, 1997). Zinc is essential in the development of young infants, but the need for zinc decreases with growth (Bedwal, Nair, & Mathur, 1991). On average, the concentration of zinc in breast milk during the first 3 months postpartum is 1-2 mg/day, but the concentration of zinc in breast milk declines over time while breastfeeding (Fung, Ritchie, Woodhouse, Roehl, & King, 1997). Fung et al. examined whether fractional zinc absorption (FZA) is altered during pregnancy and lactation. The study examined if the changes in FZA status were associated with zinc status in the mother, including dietary intake. The study was a longitudinal study that observed thirteen women at five different time points, pre-conception, first trimester, second trimester, third trimester and seven to nine weeks postpartum. The women in the study were between the ages of 22-40 years, BMI between 19-26, non-diabetic, nonsmokers, non-vegetarians, no history of drug or alcohol abuse, and no gynecological complications in the past.

FZA was measured over a two-week period, during all the time points except for during the first trimester and was obtained by a dual-stable-isotope method. Each of the participants was given a zinc-free multivitamin and a zinc tablet (4.0 mg zinc sulfate) that were consumed daily during the entire study. Before each of the tests that were performed at the five time points, the participants were asked to fast the night before starting at 10 P.M. The participants monitored their dietary intake for three nonconsecutive days, including two weekdays and one weekend day. The participants were asked to record the exact weight of the food consumed individually and the exact brand of the foods consumed. Milk samples were collected from the mothers during a 24-hour period for each of the feedings that occurred.

The results of the study showed that the total intake of zinc, dietary and supplemental, in the participants was 15.1±0.3 mg/day. From preconception to the third trimester, the participants total dietary intake of zinc increased by 23%, but the dietary intake of zinc during lactation did not significantly differ when compared both preconception and the third trimester. The intake of zinc was significantly correlated with the intake of protein at preconception, and was significantly correlated with the intake of energy and protein intake during the first trimester. Dietary zinc and iron were significantly correlated during preconception, the third trimester and lactation. The level of plasma zinc concentration decreased significantly throughout the different trimesters. The urinary concentration was not significantly different when compared at preconception and lactation. The average zinc output for breast milk was 1.72 mg/24-hour period, but overall the zinc concentration decreased with time during lactation in the participants. The study found that there was a correlation between the consumption of dairy products and the increase intake of zinc. Overall, the average zinc intake for the participants was lower than the recommendations for lactating women, and approximately ten of the thirteen participants did not meet the recommendations for zinc intake, according to the RDA (Fung, Ritchie, Woodhouse, Roehl, & King, 1997).

One study showed that during lactation there is a significant decline in milk zinc concentration for breastfeeding mothers during the first 3 months postpartum, but another study conflicts with this information by stating the plasma zinc increases through the first 12 weeks postpartum but this does not affect the levels of zinc in the milk (Krebs et al., 1995; Moser-Veillon & Reynolds, 1990). There was a correlation between the consumption of dairy and the increase in zinc intake, but the increase in zinc dietary intake had no affect on the milk concentration (Fung et al., 1997; Moser-Veillon & Reynolds, 1990).

**Section 10 – Summary**

There are multiple dietary recommendations for breastfeeding women. This can be beneficial to women because it provides them with a way to personalize their dietary choices, but it can also be confusing if they do not know which guidelines might be best for them. The recommendation for energy intake in breastfeeding women differs for each woman. However, moderate energy restriction, consuming between less than 1,700 to 2,100 kilocalories per day, is not recommended for any breastfeeding women. If a breastfeeding woman is consuming prenatal vitamins and sufficient energy in the day, then she should meet the requirements for micronutrients and macronutrients in a day. Although information in regards to the relation between dietary intake and maternal stress is lacking, women of lower socioeconomic status usually have a diet that is higher in fat and lower in the essential micro and macronutrients. These factors have a negative affect on the quality of the breast milk that the mother is producing.

Stress is also a concern for breastfeeding women. Breastfeeding women have to worry about feeding themselves and their child and consuming enough of the right nutrients to meet the needs for her and her child. However, breastfeeding women are less stressed than women who chose not to breastfeed possibly because of the hormones that are associated with lactation, including oxytocin, which provides an anti-stress effect (Uvnas-Moberg & Petersson, 2005). Socioeconomic status could be a factor that contributes to stress. When income is low, access to healthy foods is limited, which could be a contributor to a decrease in essential micro- and macronutrients in the mother's diet. Although information in regards to the relation between dietary intake and maternal stress is lacking, women of lower socioeconomic status usually have a diet that is high in fat and low in the essential micro and macronutrients. These factors have a negative affect on the quality of the breast milk that the mother is producing.

# CHAPTER III

## METHODS AND MATERIALS

### Section 1 – Background and Design

The design of the study is cross-sectional and observational. The specific location of the study is Oklahoma and it was conducted in a rural community setting. There are 86 women who predominately breastfeed their 3 month old infants participating in the study. The materials that are used in this study are the Diet History Questionnaire (DHQ), Parent Stress Index (PSI), Adult-Adolescent Parenting Inventory (AAPI-2) and a demographic form. The mothers completed the PSI, AAPI-2 and the demographic form at the initial 3-month visit. The DHQ was completed at home or in the research lab via the Internet. The Oklahoma State University Institutional Review Board approved the study's methods and procedures.

### Section 2 – Sample

The overall study sample was 110 predominately breastfeeding women at three months postpartum. Predominately breastfeeding is classified as providing less than 28 ounces of formula to the infant per week. There were 14 women who were eliminated due to defensive responding (suggesting answers were socially appropriate) on the PSI and an additional 10 women who did not complete their DHQ. This leaves a final total of 86 women. t-tests were run to determine if there was any difference between participants that were eliminated from the study and the participants that were included. There were no significant differences between the participants that remained in the study and the participants who were excluded from the study, in regards to age, marital status, income, WIC participation education, employment, number of children, Food Stamp participation, or race.

**Section 3 – Diet History Questionnaire (DHQ)**

The Diet History Questionnaire (DHQ) asks a series of questions that refers to an individual's diet over the past year. The specific nutrients that were examined from the DHQ in this study included energy (kilocalories), protein, calcium, zinc and iron intake. The National Cancer Institute provides the DHQ for researchers to use during their studies to help assess the dietary intake of the specific sample being studied. The DHQ is a food frequency questionnaire (FFQ) that was developed at the Risk Factor Monitoring and Methods Branch of the National Cancer Institute and consists of 124 questions relating to food intake, including portion sizes and dietary supplementation ("Diet history questionnaire", 2009). The mother completed the DHQ on her own time via the Internet using a web-based survey tool through the DHQ website. If the mother does not have a computer, a copy of the DHQ was provided. The study staff monitored the mother's progress on the DHQ and sent out reminders via mail and email if the mother had not completed her DHQ within 2 weeks of receiving the questionnaire. Diet*Calc software version 1.4.3 was used to estimate nutrient intake based on the food frequency data from the DHQ form. The Diet*Calc software also estimates the pyramid food groups as the variables that represent standard food serving sizes and the recommended food groups that a person should be consuming. Age of the participants in the study was obtained from the DHQ information. According to a study published in the American Journal of Epidemiology, the DHQ is a better indicator of the absolute intake of nutrients when compared to the Willett Food Frequency Questionnaire (Subar et al., 2001).

**Section 4 – Parenting Stress Index (PSI)**

The Parenting Stress Index (PSI), short form, is a questionnaire that contains 36 questions that relate to the mother's stress. The four different subscales of the Parenting Stress Index include Parental Distress (PD), Parent-Child Dysfunctional Interaction (P-CDI), Difficult Child (DC), and Defensive Responding (DR). DR is a way to see if the mother is falsifying her answers due to what she thinks is the "correct" response. If the mother scores 10 or less on the designated questions then the participant was excluded. For PD the questions ask if the mother thinks her child rarely does anything good for her, or if the child smiles at her much less than she would expect. The questions for P-CDI refer to the feelings of warmth and if their child makes the mother feel bothered or in a bad mood. The DC subscale questions if her child is more of a problem than expected or if the child is more demanding than other children. The mothers responding to each of the 36 questions by answering strongly agree, agree, not sure, disagree or strongly disagree. The means are different for each of the PSI scales, for example, the 50$^{th}$ percentile for PD and DC is 25, but PCDI has a 50$^{th}$ percentile of 19 (PSI, 2010). In 1996, a study was conducted to assess the validity and reliability of the PSI-short form, and found that the PSI is a reliable and valid tool used to evaluate parenting stress (Bigras, LaFreniere, Dumas, 1996).

**Section 5 – AAPI-2 (Adult-Adolescent Parenting Inventory) and Demographic Form**

The AAPI-2 was used to obtain demographic information, including marital status, income, number of children and education. The mothers completed the AAPI-2 form on a computer in the research lab during the three month visit. The categorical selections for marital status on the AAPI-2 included single, married, divorced, unmarried partners, separated, and widowed. The divorced and separated options were added together when analyzing the results of the study. The income options were as follows:

| | | | | | |
|---|---|---|---|---|---|
| Unknown | Under $15,000 | $15,001-25,000 | $25,001-40,000 | $40,001-60,000 | Over $60,000 |

The number of children in the family was obtained by answering, “how many children do you have” (AAPI, 2006 a).

Education information for the women in the study were obtained by asking the highest grade that was completed in school, and the categories included:

| | | | | |
|---|---|---|---|---|
| Unknown | Grade School | 7th Grade | 8th Grade | 9th Grade |
| 10th Grade | 11th Grade | High School Grad | Some College | Post-Graduate or above |

The AAPI-2 form has an internal reliability of 0.80 to 0.93 for both part A and part B, according to the Spearman-Brown and the Cronbach (AAPI, 2006 b). The Demographic form was used to determine the gender of the baby. The form asked specifically for the gender of the baby, giving the options of male or female.

**Section 6 – Statistical Analysis**

SPSS version 19.0 was used to analyze the data. Descriptive statistics, including mean and standard deviation, were computed from dietary, stress and demographic variables. For the first aim, mean intakes of the group will be compared to EAR values to determine percentages of women consuming adequate amounts of nutrients (Institute of Medicine, 2000). For the second aim, correlation analysis were conducted first to describe the relationship between variables and then regression analysis was done using those variables identified as significant in the correlation analysis. PSI subscale scores and demographic characteristics were the independent variables and dietary intake variables were the dependent variables. A separate regression was run for each nutrient of interest. Significance will be determined as $p < 0.05$.

# CHAPTER IV

# RESULTS

First, this study examined the overall dietary intake of breastfeeding women. The dietary intake of the participants was then compared to the Dietary Reference Intake (DRI), specifically Estimated Average Requirements (EAR), Adequate Intake (AI) and Recommended Dietary Allowance (RDA). Next, we examined the four components of stress from the PSI form and the demographic characteristics of the sample, specifically marital status, household income, age, and employment status. Finally, the study had specific nutrients of interest, including iron, calcium, zinc, protein and energy. These specific nutrients were examined to see if there were any relations between dietary intake, the demographic characteristics, and parenting stress.

**Section 1 – Demographics of Study Sample**

The women in this sample were predominately white (84.9%) with a mean age of 28.2 ± standard deviation of 4.6. The women lived in rural Oklahoma, with an average of 1.9 ± 1.1 children in the household. Approximately 94.3% of the participants completed some college or higher, indicating a highly educated sample. Almost 60% of the women were unemployed. Most women in the study did not participate in WIC or Food Stamps, although the median annual income was between $25,001-$40,000. Table 1 below describes the specific demographic features of this sample.

**Table 1: Demographic Feature**

| **Variable** | **[n(%)]** | **(Mean±SD)** |
|---|---|---|
| Race | | |
| White | 73 (84.9) | |
| Native American | 7 (8.1) | |
| Hispanic | 2 (2.3) | |
| Asian | 2 (2.3) | |
| Other | 2 (2.3) | |
| Education | | |
| High School Graduate | 5 (5.8) | |
| Some College | 28 (32.6) | |
| College Graduate | 25 (29.1) | |
| Post-Graduate or above | 28 (32.6) | |
| Employment | | |
| Employed Full Time | 18 (20.9) | |
| Employed Part Time | 17 (19.8) | |
| Unemployed/Retired | 51 (59.3) | |
| Household Income Level | | |
| Unknown | 1 (1.2) | |
| Under $15,000 | 12 (14.0) | |
| $15,001-$25,000 | 17 (19.8) | |
| $25,001-$40,000 | 20 (23.3) | |
| $40,001-$60,000 | 21 (24.4) | |
| $Over $60,000 | 15 (17.4) | |
| Marital Status | | |
| Unmarried Partners | 6 (7.0) | |
| Married | 76 (88.4) | |
| Separated/Divorced | 4 (4.6) | |
| WIC Participation | | |
| No | 62 (72.1) | |
| Yes | 24 (27.9) | |
| Food Stamps | | |
| No | 78 (90.7) | |
| Yes | 8 (9.3) | |
| Baby's Gender | | |
| Female | 57 (66.3) | |
| Male | 29 (33.7) | |

**Section 2 – Parenting Stress Index-Short Form (PSI)**

The results of the PSI showed that the participants in the study were in the 60$^{th}$ percentile for Parental Distress, the 45$^{th}$ percentile for Parent-Child Dysfunctional Interaction, in the 30$^{th}$ percentile for Difficult Child and in the 45$^{th}$ percentile for Total Stress (Parenting Stress Index-

Short form, 2010). Overall, the participants were not highly stressed in regards to the categories on the PSI-short form.

**Table 2: Means of PSI (n=86)**

| PSI | (Mean±SD) | Percentage |
|---|---|---|
| PSI_PD | 26.90 ±7.4 | 60% |
| PSI_PCDI | 17.83±4.9 | 45% |
| PSI_DC | 22.29±6.9 | 30% |
| PSI_TotalStress | 67.37±16.7 | 45% |

**Section 3 – Descriptive Statistics for Dietary Intake**

Estimates for all nutrient values provide by Diet Calc are in Appendix I. The estimated dietary intake results were calculated from the DHQ results and were compared to the values of the DRI, including EAR, (Table 3), AI, (Table 4), and RDA, (Table 5), values. Nutrient values calculated from the DHQ are presented as mean and standard deviation. A frequency distribution was run to determine the amount of participants that were consuming less than the recommended amount for EAR, RDA, and AI. The comparison between the specific DRI values, including EAR, RDA, and AI, and the estimated intake means were determined by a one sample t-test.

Overall, women in this study had an adequate diet. The average energy intake was 2,052 kilocalories (8586 kJ), with an average macronutrient intake of 270 g carbohydrate, 82 g protein and 76 g total fat with 27 g from saturated fat. However, 32.6% of the sample consumed less than 1,700 kilocalories per day. The EAR is the estimated intake required to meet the needs of 50% of the population (Dietary guidance, 2009). Table 3 indicated that estimated intakes of the group did not meet the EAR for vitamin E, vitamin D and folate. Additionally, approximately 42.8% of the participants did not meet the EAR for protein intake (1.05 g/kg). When compared to the EAR, 40.7% of the sample did not consume enough vitamin C (100 mg recommended by EAR) and. There were new DRI values recommended for vitamin D and calcium in 2010. The new recommendations for calcium are 800 mg (EAR) and 1,000 mg (RDA) (Office of Dietary Supplements: Calcium, 2011). The new recommendations for vitamin D are 10 µg (EAR) and 15 μg (RDA) (Office of Dietary Supplements: Vitamin D, 2011). The *p* values below are from t-tests that compare the mean value of the groups  estimated intake to the EAR value.

**Table 3: Dietary Reference Intakes (DRIs): Estimated Average Requirements for Lactating Women[5] (19-30 years) (DRI, 2006)**

| **Nutrient per Day** | **EAR** | **% Less than EAR** | **Mean** | **SD** | ***p* Value** |
|---|---|---|---|---|---|
| CHO (g) | 160 | 12.8 | 270.3 | 116.1 | .000* |
| Protein (g/kg) | 1.05 | 42.4 | 1.2 | 0.5 | .009* |
| Vitamin A (μg) | 900 | 22.1 | 1408.2 | 653.2 | .000* |
| Vitamin C (mg) | 100 | 40.7 | 150.2 | 151.5 | .003* |
| **Vitamin E (mg)** | **16** | **90.7** | **9.7** | **4.8** | **.000*** |
| Thiamin (mg) | 1.2 | 19.8 | 1.7 | 0.7 | .000* |
| Riboflavin (mg) | 1.3 | 12.8 | 2.3 | 0.9 | .000* |
| Niacin (mg) | 13 | 14.0 | 22.0 | 8.0 | .000* |
| Vitamin $B_6$ (mg) | 1.7 | 25.6 | 2.10 | 0.8 | .000* |
| **Folate (μg)** | **450** | **68.6** | **411.2** | **177.8** | **.046*** |
| Vitamin $B_{12}$ (μg) | 2.4 | 9.3 | 5.2 | 2.2 | .000* |
| Copper (g) | 1.0 | 25.6 | 1.4 | 0.6 | .000* |
| Iron (mg) | 6.5 | 4.7 | 16.6 | 6.1 | .000* |
| Magnesium (mg) | 255 | 19.8 | 344.8 | 134.3 | .000* |
| Phosphorus (mg) | 580 | 5.8 | 1542.9 | 593.6 | .000* |
| Selenium (μg) | 59 | 17.4 | 95.9 | 32.8 | .000* |
| Zinc (mg) | 10.4 | 10.4 | 13.1 | 5.4 | .000* |
| **Vitamin D (μg)** | **10** | **90.7** | **5.8** | **3.6** | **.000*** |
| Calcium (mg) | 800 | 26.7 | 1161.5 | 604.1 | .000* |

Iodine and Molybdenum were not included because the results were not available from the DHQ for these nutrients. (IOM, 2010)

The AI, (Table 4) set when there is no RDA for a specific nutrient (Dietary guidance, 2009), was higher than the estimated intake for fiber, potassium, and linoleic acid and α-linolenic acid just met the AI requirement. The evaluation of the estimated level of nutrient intake to meet approximately 97-98% of the sample's needs, known as RDA (Table 5; Dietary guidance, 2009), identified nutrients similar to those identified by the EAR. Specifically, the majority of the group had inadequate intakes of vitamin E, vitamin D and folate when compared to RDA values, while

[5] *Contains cells that had significant differences between the nutrient intake and the EAR recommendation variables with α=.05.

as  when intakes of vitamin A, vitamin C, vitamin $B_6$, zinc and copper were not significantly different than the RDA value.

**Table 4: Dietary Reference Intakes (DRIs): Adequate Intake for Breastfeeding Women (19-30 years) (DRI, 2006)**[6]

| Nutrient per Day | AI | % Less Than AI | Mean | SD | *p* Value |
|---|---|---|---|---|---|
| **Potassium (mg)** | **5100** | **94.2** | **3366.9** | **1452.2** | **.000*** |
| Sodium (mg) | 1500 | 4.7 | 3190.7 | 1129.1 | .000* |
| **Total Fiber (g)** | **29** | **89.5** | **19.7** | **7.7** | **.000*** |
| *Linoleic Acid (g)* | *13* | *51.2* | *13.1* | *5.9* | *.822* |
| *α- Linolenic Acid (g)* | *1.3* | *51.2* | *1.3* | *0.5* | *.852* |

Vitamin K, Panothenic Acid, Biotin, Choline, Chromium, Fluoride, Manganese, Chloride, and total water were not included for AI because the results for these nutrients were not available from the DHQ.

[6] Contains cells that had significant differences between the nutrient intake and the AI recommendation variables with α=.05.

**Table 5: Dietary Reference Intakes (DRIs): Recommended Dietary Allowances for Breastfeeding Women (19-30 years) (DRI, 2006)** [7]

| **Nutrient per Day** | **RDA** | **% Less Than RDA** | **Mean** | **SD** | ***p* Value** |
|---|---|---|---|---|---|
| *Vitamin A (μg)* | *1,300* | *45.3* | *1408.2* | *653.2* | *.128* |
| *Vitamin C (mg)* | *120* | *54.7* | *150.2* | *151.5* | *.068* |
| **Vitamin E (mg)** | **19** | **95.3** | **9.7** | **4.8** | **.000*** |
| Thiamin (mg) | 1.4 | 31.4 | 1.7 | 0.6 | .000* |
| Riboflavin (mg) | 1.6 | 19.8 | 2.3 | 0.9 | .000* |
| Niacin (mg) | 17 | 29.1 | 22.0 | 8.0 | .000* |
| *Vitamin $B_6$ (mg)* | *2.0* | *48.8* | *2.1* | *0.8* | *.247* |
| **Folate (μg)** | **500** | **77.9** | **411.2** | **177.8** | **.000*** |
| Vitamin $B_{12}$ (μg) | 2.8 | 14.0 | 5.2 | 2.2 | .000* |
| *Copper (g)* | *1.3* | *46.5* | *1.4* | *0.6* | *.124* |
| Iron (mg) | 9 | 14.0 | 16.6 | 6.1 | .000* |
| Magnesium (mg) | 310 | 43.0 | 344.8 | 134.3 | .019* |
| Phosphorus (mg) | 700 | 8.1 | 1542.9 | 593.6 | .000* |
| Selenium (μg) | 70 | 23.3 | 95.9 | 32.8 | .000* |
| *Zinc (mg)* | *12* | *45.3* | *13.1* | *5.4* | *.056* |
| **Vitamin D (μg)** | **15** | **98.8** | **5.8** | **3.6** | **.000*** |
| Calcium (mg) | 1,000 | 41.9 | 1161.5 | 604.1 | .000* |
| Carbohydrate (g) | 210 | 23.3 | 270.3 | 116.1 | .000* |
| Protein (g) | 71 | 36.0 | 82.2 | 29.0 | .001* |

Iodine and Molybdenum were removed because the results were not available from the DHQ for these nutrients.

*Dietary Intake plus Supplements*

A majority of mothers (80%) in the sample took supplemental vitamins even after the delivery of their baby. The dietary intake and the supplemental consumption of the mothers were added together to calculate the total amount of each nutrient that was consumed by the mother. All mean intakes were appropriate, although a small percentage of individuals remained at potential risk.

[7] Contains cells that had significant differences between the nutrient intake and the RDA recommendation variables with α=.05.

**Table 6: Dietary Intake plus Dietary Supplements Compared to EAR (n=86)**

| Nutrient | EAR | % less than EAR | Mean | SD | Min | Max |
|---|---|---|---|---|---|---|
| Magnesium (mg) | 255 | 12.8 | 386.2 | 142.3 | 108.5 | 912.3 |
| Iron (mg) | 6.5 | 2.3 | 26.8 | 12.4 | 5.7 | 70.5 |
| Zinc (mg) | 10.4 | 8.1 | 19.4 | 7.7 | 4.0 | 43.6 |
| Copper (g) | 1.0 | 8.1 | 2.2 | 0.9 | 0.4 | 5.3 |
| Vitamin D (μg) | 10 | 14.0 | 184.3 | 125.9 | 0.8 | 307.5 |
| Selenium (μg) | 59 | 17.4 | 95.9 | 32.8 | 32.0 | 189.4 |
| Thiamin (mg) | 1.2 | 8.1 | 2.6 | 1.6 | 0.6 | 11.3 |
| Riboflavin (mg) | 1.2 | 3.5 | 3.2 | 1.6 | 0.6 | 12.2 |
| Niacin (mg) | 13 | 7.0 | 31.7 | 12.6 | 8.4 | 79.7 |
| Vitamin B6 (mg) | 1.7 | 10.5 | 5.2 | 8.8 | 0.7 | 46.2 |
| Vitamin B12 (μg) | 2.4 | 3.5 | 7.8 | 3.2 | 1.1 | 19.8 |
| Calcium (mg) | 800 | 23.3 | 1238.6 | 630.2 | 252.8 | 3785.3 |
| Vitamin A (μg) | 900 | 8.1 | 2077.6 | 856.7 | 213.9 | 4195.4 |
| Vitamin E (mg) | 16 | 38.4 | 18.5 | 8.9 | 2.9 | 52.8 |
| Vitamin C (mg) | 100 | 20.9 | 185.0 | 165.9 | 27.2 | 1348.2 |

The dietary intake of the subjects was also broken down into food groups that were consumed. Although there is not a standard to compare the intake of food groups for lactating women, it is interesting to see what the intake of food groups is for this sample. Despite the appropriate distribution of macronutrients, the amounts of kilocalories represented by discretionary fat and added sugar are of concern; the results are shown in Table 7.

**Table 7: Number of Servings (n=86)**

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| Total Grain Servings | 5.6 | 2.2 | 1.7 | 10.72 |
| Whole Grain | 1.3 | 0.6 | 0.2 | 2.8 |
| Non-Whole Grain | 4.3 | 1.9 | 1.2 | 8.9 |
| Total Vegetable Servings | 3.7 | 1.9 | 0.7 | 11.5 |
| Dark Green Vegetable Servings | 0.3 | 0.4 | 0.0 | 2.5 |
| Deep-Yellow Vegetable Servings | 0.3 | 0.3 | 0.0 | 1.2 |
| Dry Bean and Pea Servings | 0.2 | 0.2 | 0.0 | 1.3 |
| White Potato Servings | 0.7 | 0.6 | 0.0 | 3.5 |
| Other Starchy Vegetable Servings | 0.3 | 0.6 | 0.0 | 1.4 |
| Tomato Servings | 0.6 | 0.4 | 0.1 | 2.7 |
| Other Vegetable Servings | 1.4 | 0.9 | 0.2 | 6.3 |
| Total Fruit Servings | 2.9 | 2.65 | 0.2 | 20.8 |
| Citrus/Melon/Berry Servings | 1.3 | 2.03 | 0.1 | 17.5 |
| Other Fruit Servings | 1.6 | 1.14 | 0.0 | 6.9 |
| Total Dairy Servings | 2.7 | 1.84 | 0.3 | 10.8 |
| Milk Servings | 1.8 | 1.50 | 0.1 | 7.8 |
| Yogurt Servings | 0.2 | 0.22 | 0.0 | 0.8 |
| Cheese Servings | 0.7 | 0.56 | 0.1 | 3.0 |
| Lean Meat from Meat/Poultry/Fish (oz.) | 3.3 | 1.6 | 0.8 | 8.6 |
| Lean Meat from Beef/Pork/Lamb/etc. (oz.) | 1.6 | 1.0 | 0.3 | 5.3 |
| Lean Meat from Organ Meats (oz.) | 0.0 | 0.0 | 0.0 | 0.1 |
| Lean Meat from Franks/Luncheon Meats (oz.) | 0.5 | 0.4 | 0.0 | 2.0 |
| Lean Meat from Poultry (oz.) | 0.9 | 0.7 | 0.0 | 3.6 |
| Lean Meat from Fish/Other Seafood (oz.) | 0.3 | 0.2 | 0.0 | 1.1 |
| Lean Meat Equiv. from Eggs (oz.) | 0.3 | 0.2 | 0.0 | 1.0 |
| Lean Meat Equiv. from Soy Products (oz.) | 0.1 | 0.2 | 0.0 | 1.2 |
| Lean Meat Equiv. from Nuts/Seeds (oz.) | 0.5 | 0.5 | 0.0 | 3.6 |
| Grams of Discretionary Fat (oz.) | 60.9 | 26.4 | 19.7 | 134.1 |
| Teaspoons of Added Sugar (oz.) | 17.2 | 12.9 | 3.0 | 79.4 |
| Total Drinks of Alcohol | 0.0 | 0.1 | 0.0 | 0.5 |

**Section 4 – Dietary Intake and Demographic Characteristics and Stress**

No significant correlation was observed between marital status, age, income and employment status and any of the estimated intakes of the nutrients of interest. These variables were not considered in the regression model. Dietary intake and components of maternal stress were significantly correlated. The specific stress factors that were significant in relation to dietary factor were Difficult Child (DC) and Parent-Child Dysfunctional Interaction (PCDI). Each of the dietary factors were related to the three stress factors from the PSI form, including DC, PCDI, and Parental Distress (PD) in a regression model. Total stress was not used in the regression analysis, as total stress scores are the sum of the three components of stress from the PSI form.

*Kilocalories per kilogram: Pre-pregnancy Weight*

The relation between the three stress factors and the intake of kilocalories (Kcal) per day, explained 14% of the variance [$F(3,82) = 4.52$, $p = .005$] in calorie intake. The stress factors that were most influential in the relation between energy intake and stress were PCDI ($p = .008$) and DC ($p = .007$). PCDI was negatively correlated to energy intake and DC was positively correlated to energy intake. Kcal/kg, based on the subject's pre-pregnancy weight, was calculated and compared to the three stress factors. The relation between the three stress factors and the intake of kcal/kg explained 12% of the variance [(F(3,80) = 3.55, $p$ =.018]. When comparing the stress factors and kcal/kg, DC ($p = .026$) is the only significant variable, but it is the more accurate calculation for calorie intake because it is standardized for differences in initial weight.

**Table 8: Regression Results Examining Energy Intake as Kcal/kg of pre-pregnant weight and PSI Stress Factors**

**Coefficients**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Correlations | | |
|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Zero-order | Partial | Part |
| 1 | (Constant) | 14.687 | 8.410 | | 1.746 | .085 | | | |
| | PSI_PD | .522 | .267 | .219 | 1.957 | .054 | .240 | .214 | .206 |
| | PSI_PCDI | -.642 | .424 | -.190 | -1.512 | .135 | .025 | -.167 | -.159 |
| | PSI_DC | .712 | .313 | .283 | 2.276 | .026* | .247 | .247 | .239 |

a. Dependent Variable: kcal_prepreg

*Contains cells that had significant differences between the two variables with α=.05.

*Protein Intake (grams/day)*

The intake of proteins in grams per day, the second model was significant [$F(3,82) = 3.66$, $p = .016$] explaining variance of about 12%. Specifically, PCDI ($p = .009$) and DC ($p = .026$) were the two factors that influenced the relation between protein intake and parenting stress. DC was positively correlated to protein intake and PCDI was negatively correlated to protein intake. Protein (g/kg) was not significantly related to any of the three PSI factors [F(3,82) = 2.20, *p* =.094].

**Table 9: Regression Results Examining Protein Intake (g/day) and PSI Stress Factors**

**Coefficients**

| Model 2 | | Unstandardized Coefficients B | Std. Error | Standardized Coefficients Beta | t | Sig. | Correlations Zero-order | Partial | Part |
|---|---|---|---|---|---|---|---|---|---|
| 1 | (Constant) | 70.836 | 13.406 | | 5.284 | .000 | | | |
| | PSI_PD | .747 | .467 | .191 | 1.599 | .114 | .170 | .174 | .166 |
| | PSI_PCDI | -2.101 | .786 | -.357 | -2.673 | .009* | -.090 | -.283 | -.277 |
| | PSI_DC | 1.288 | .566 | .305 | 2.274 | .026* | .175 | .244 | .236 |

a. Dependent Variable: Protein - g

*Contains cells that had significant differences between the two variables with α=.05.

*Calcium Intake*

Model three, the relation between calcium intake and the three stress factors, was statistically significant [*F*(3,82) = 5.53, *p* = .002] explaining 17% of variance. The two stress factors that made a significant impact of the relation between calcium and stress were PCDI (*p* = .001) and DC (*p* = .005). PCDI was again negatively correlated to calcium intake and DC was positively correlated to calcium intake. When calcium supplementation and dietary intake were added together, the relation between stress and calcium intake was significant [F(3,82) = 4.59, *p = .005*], and accounted for a variance of 11.2%. When total intake of calcium was calculated, PCDI (*p* = .003) and DC (*p* = .012) were the two significant stress variables.

**Table 10: Regression Results Examining Dietary Calcium Intake and PSI Stress Factors**

**Coefficients**

| Model 3 | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. | Correlations Zero-order | Correlations Partial | Correlations Part |
|---|---|---|---|---|---|---|---|---|---|
| 1 | (Constant) | 923.448 | 270.881 | | 3.409 | .001 | | | |
| | PSI_PD | 17.339 | 9.445 | .213 | 1.836 | .070 | .186 | .199 | .185 |
| | PSI_PCDI | -53.662 | 15.884 | -.439 | -3.378 | .001 | -.121 | -.350 | -.340 |
| | PSI_DC | 32.672 | 11.446 | .372 | 2.854 | .005 | .203 | .301 | .287 |

a. Dependent Variable: Calcium - mg

*Contains cells that had significant differences between the two variables with $\alpha$=.05.

*Iron Intake*

The fourth model was statistically significant [$F(3,82) = 3.22$, $p = 0.027$], explaining 11% of the variance. Specifically, PCDI ($p = .009$) and DC ($p = .17$) were the two stress factors that were statistically significant, PCDI was negatively correlated to iron intake and DC was positively correlated to iron intake. When supplement intake and dietary intake of iron were combined, the regression became insignificant [$F(3,82) = 1.48$, $p = .227$], with a variance of 5.1%.

**Table 11: Regression Results Examining Iron Intake and PSI Stress Factors**

**Coefficients**

| Model 4 | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. | Correlations Zero-order | Correlations Partial | Correlations Part |
|---|---|---|---|---|---|---|---|---|---|
| 1 | (Constant) | 15.582 | 2.845 | | 5.477 | .000 | | | |
| | PSI_PD | .092 | .099 | .111 | .923 | .359 | .098 | .101 | .096 |
| | PSI_PCDI | -.448 | .167 | -.362 | -2.687 | .009* | -.116 | -.284 | -.281 |
| | PSI_DC | .292 | .120 | .328 | 2.428 | .017* | .160 | .259 | .254 |

a. Dependent Variable: Iron - mg

*Contains cells that had significant differences between the two variables with $\alpha$=.05.

*Zinc Intake*

The relation between the dietary intake of zinc and the three stress factors, model five, is statistically significant [$F(3,82) = 4.15$, $p = .009$), explaining 13% of the variance. The two stress components that effected the relation of zinc and stress were PCDI ($p = .007$) and DC ($p = .009$), where PCDI was negatively correlated to zinc intake and DC was positively correlated to zinc intake. When zinc dietary intake and supplemental intake were combined, the regression between zinc intake and stress was not significant, [F(3,82) = 1.31, $p = .275$].

**Table 12: Regression Results Examining Zinc Intake and PSI Stress Factors**

**Coefficients**

| Model 5 | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. | Correlations Zero-order | Correlations Partial | Correlations Part |
|---|---|---|---|---|---|---|---|---|---|
| 1 | (Constant) | 10.778 | 2.484 | | 4.340 | .000 | | | |
| | PSI_PD | .122 | .087 | .166 | 1.404 | .164 | .164 | .153 | .144 |
| | PSI_PCDI | -.404 | .146 | -.368 | -2.773 | .007* | -.080 | -.293 | -.285 |
| | PSI_DC | .282 | .105 | .358 | 2.686 | .009* | .210 | .284 | .276 |

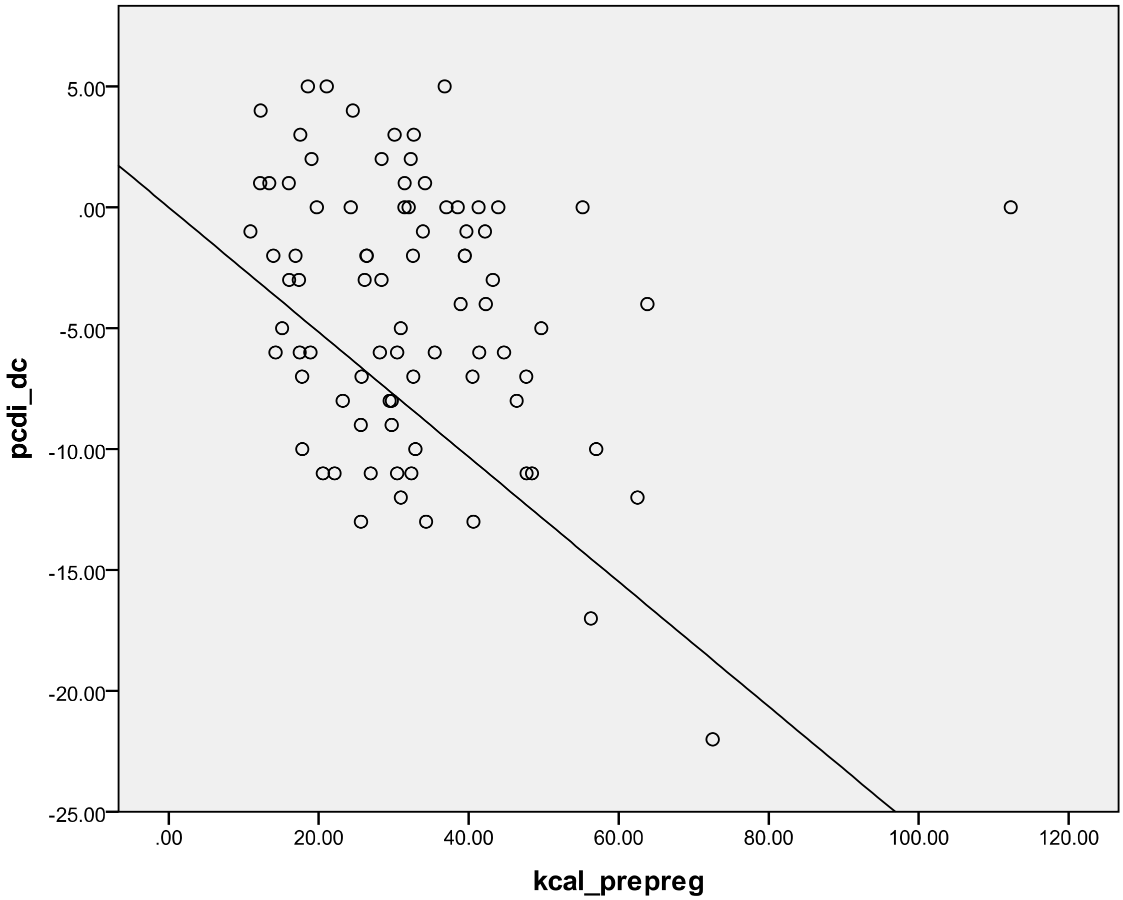
a. Dependent Variable: Zinc – mg

*Contains cells that had significant differences between the two variables with α=.05.

*Dietary Intake and Three Stress Scales*

There was a consistent pattern in the relation between stress and dietary intake for each nutrient examined. The PSI_PCDI scale was negatively correlated, whereas PSI_PD and PSI_DC were positively correlated. To further examine this relation a new variable was computed by subtracted the raw score for the DC stress from the raw score of the PCDI stress (PCDI-DC). A correlation analysis examined the relation this variable and the kilocalories, Protein, Fe, Zn, and Ca. The relation between the dietary intake of kilocalories (based off pre-pregnancy weight) and PCDI-DC is statistically significant [$F(1,82) = 5.84$, $p = .018$). Figure 1 shows the relation between kilocalories and PCDI-DC. Kilocalories were chosen because the changes in intake of kilocalories change the intake of the other nutrients of interest. Results suggest that parenting a child who is both difficult to care for and is less responsive most affects dietary intake. When the mother is experiencing PCDI stress more than DC stress there is lower food consumption, but the opposite occurs if DC stress is greater than PCDI stress. .

**Figure 1: Correlation Between PCDI-DC and Kilocalories**



# CHAPTER V

## CONCLUSIONS AND DISCUSSION

**Section 1: Conclusions**

The women in the sample for this study were predominately white, highly educated, married, and unemployed. Interestingly, the research staff observed that many of the mother's that were unemployed were students at the university, or also stay at home moms. The average number of children for the group of participants was two children. The average household income for this sample was between $25,001-$40,000 dollars per year. This is a low average annual income considering most the women in the study are married and highly educated, but can be explained by the low employment rate of this sample. The socioeconomic factors examined in this study, maternal age, income, and marital status, had no effect on the dietary intake of the participants, perhaps because of the high education levels.

*Macro and Micronutrients*

The average dietary intake of the micronutrients for the subjects met the EAR for most of the micronutrients. Greater than 40% of the population did not meet the needs of vitamin C, D, E, folate and protein (g/kg) when compared to the EAR. Carbohydrate recommendations were sufficiently met when compared to the EAR recommendations. Mean protein intake was , however 42.4 percent of the sample was at risk as they consumed less than the EAR recommendations for protein, based on g/kg. This reinforces that dietary intake is individualized and should be treated that way for purposes of assessment. The percentage of energy from protein (16%), fat (33%) and carbohydrates (52%) was comparable to the recommended 15% from protein, 30% from fat and 55% from carbohydrates The mean intake for the women in the study showed an overall, well-rounded diet.

*Vitamins and Supplements*

Most women were still taking supplements, which helped compensate for the individual problems in nutrient consumption in their diet. When comparing the dietary intake of the sample to the Estimated Average Requirements (EAR), the nutrients of concern were vitamin E, vitamin C, vitamin D, protein (g/kg), and folate. Vitamin E, vitamin C, and vitamin D intake was improved when supplemental intake was added to dietary intake for the subjects. However, even after supplementation intake of vitamin E and C and calcium remained among in over 20 percent of sample, according to the Adequate Intake (AI) values.

*Food Groups*

The Food Guide Pyramid does not have specific food group recommendations for breastfeeding mothers. A mother can fill out her personal information, including age, baby's birthdate, etc., and determine the plan that is best for her individually, but there are no "standard" values for the recommended serving sizes for specific food groups for the breastfeeding sample. The women in this study had an average consumption of 5.6 total grains/d, 3.7 total vegetable servings/d, 2.9 total fruit servings/d, and 2.7 total dairy servings/d. The amount of discretionary fat was 60.94 g/d, which is a high amount of extra fat in the diet. An interesting finding was the amount of added sugar to the diet, which on average was 17.2 tsp/d. This is a lot of excess discretionary kilocalories added to the mother's diet.

*Stress and Dietary Intake*

Stress among the mothers in this sample was within typical or average ranges, according to the parenting stress index. Parent Child Difficult Interaction (PCDI) and Difficult Child (DC) were the two subscales of stress that were consistently related to the dietary intake of the mothers. PCDI subscale asks questions referring to the feelings of warmth and if the mother's child makes her feel bothered or in a bad mood. DC subscale questions whether the mother's child is more of a problem than expected or if the child is more demanding than other children (PSI, 2010). The interesting finding was that the two different subscales related to the dietary habits of the breastfeeding mothers in opposite ways. A correlation analysis was conducted and when PCDI stress was greater than DC stress, the mother had a lower dietary intake, but when DC was great than PCDI stress there was a higher dietary intake.. In summary, there is a relation between when the mother is feeling bothered or in a bad mood because of her child and a decrease in dietary intake, but there is also a relation between the mother feeling like she has a more demanding or troublesome child and an increase in dietary intake. Parenting a child who is both difficult to care for and is less responsive, most affects dietary intake

When dietary intake and supplemental intake were combined, the regression for relation between zinc and stress, and iron and stress was not significant. When the dietary intake of calcium was added to the supplemental intake, the model was still significant, but slightly less significant. This helps to understand that it is the relation between dietary intake and stress that is significant, not necessarily the supplemental use.

**Section 2 – Relationship of Findings to the Literature**

*Demographic Factors*

Income did not affect the dietary intake of our breastfeeding women, which is different than the findings from Qian et al., which found that lower income had an impact on dietary intake of protein, lipids, Na, K, P and Ca (Qian, Chen, Lu, Wu, & Zhu, 2010). The average annual income for our sample was $25,001-$40,000, which is considered 133 - 175% of the poverty level for a family of four (U.S. Department of Health and Human Services, 2011). Low-income women did not meet the recommended daily intake of vegetables, fat or dairy, when compared to the Food Guide Pyramid (George, Hannss-Nuss, Milani, Freeland-Graves, 2005). Olson found that women of lower income consumed less than 2 servings of fruits and vegetables, which was not the case in our group of breastfeeding women. The breastfeeding women in our study had a high intake of dietary fat, which was similar to the findings of George et al.

The majority of our breastfeeding mothers were unemployed (59.3%), but continued to breastfeed their infants, which is different than the findings from Heck et al., who found that lower occupational status or unemployment was associated with not breastfeeding (Heck, Braveman, Cubbin, Chavez, Kiely, 2006). The relatively high rate of unemployment may have been due to the number of students participating in the study. Although the number of unemployed participants was high, the education level of the sample was also high; approximately 94.3% have some college or more. Maternal age, education, and marital status did not affect the dietary intake of our breastfeeding participants. This may indicate a threshold effect, with a lack of variability in education, limiting the chance of relations with other variables and diet.

*Dietary Intake*

Overall the mothers in the study had a relatively well-balanced diet. On average, the women consumed enough of the essential micro and macronutrients when compared to the EAR, with the exception of vitamin C, vitamin E, folate, vitamin D and protein. The women also exhibited low intakes of total fiber, linoleic acid and α-linolenic acid. An interesting finding was the amount of extra fat and discretionary sugars that were being consumed by the mothers. On average, 17.2 teaspoons of sugar were added to the diet and 60.9 grams of added fat. The added sugar could be explained by the intake of soda pop, adding sugar to coffee or adding to foods to enhance the flavor. The amount of discretionary fat that is in the mother's diet could be due to the limited availability of healthy foods, due to the lower income sample. Fast food, fried foods and low cost foods are calorically dense but lack in nutrient content. The high amount of added fat in the diet can also affect the mother's breast milk. The mother's increase in fat in the diet causes an increase in fat in the mother's breast milk content. The mother is then feeding her infant a diet that is high in fat content, which could possibly cause weight gain or obesity in her infant

(Mohammad, Sunehag, Haymond, 2009). The average caloric intake for our mothers was 2,052 kilocalories per day, which is close to the amount consumed by women in past studies (Butte,Garza, Stuff, Smith, Nichols, 1984). A past study found mothers who breastfed up to one year postpartum were more likely to consume at least three servings of fruits and vegetables per day, but were not more likely to consume two or more servings of milk per day (Olson, 2005), and the mothers in our study consumed more than 2 servings of milk but consumed slightly less than 3 servings of fruit per day.

A recent study was published that examined the dietary intake of mothers (n = 450) during 6 and 9 weeks postpartum that were breastfeeding or formula feeding, and considered overweight (Durham, Lovelady, Brouwer, Krause, & Ostbye, 2011). Two 24-hour recalls were performed for each of the subjects via the telephone. The results of this study found breastfeeding women in the study consumed more energy than formula feeding women, with an average of 2,407 kilocalories per day, but the percentage of energy from protein, carbohydrates and fat were within acceptable ranges for nutrient intake. When the mother's intake was compared to EAR values, vitamins A, E, C, and folate were inadequate, including calcium when compared to AI. The study compared the mothers food group intake to MyPyramid for Moms, by using standardized reference women since MyPyramid for Moms is individualized, and found that the subjects did not meet the recommended servings of fruits, vegetables, grains, dairy, meat or fat. Also, the breastfeeding women in the study consumed more discretionary kilocalories when compared to formula feeding mothers (Durham, Lovelady, Brouwer, Krause, & Ostbye, 2011).

These results are similar to the results found in our study. Although we did not have formula feeding group to compare our breastfeeding group to, the mothers in our study consumed an average of 2,052 kilocalories, which is comparable to the 2,107 kilocalories per day in the Durham et. al study. Also, the women in our study did not meet the recommended intake of vitamin E, vitamin C, vitamin D, protein (g/kg), and folate, when compared to the EAR and AI, which is comparable to the nutrient deficiencies in the Durham et. al study. There was a large amount of discretionary fat (60.9 grams) and added teaspoons of sugar (17.2) in the dietary intake of our moms, which is similar to the increase in discretionary calories in the Durham et. al study.

*Kilocalories, Protein, Calcium, Zinc and Iron*

The nutrients of focus for this study included kilocalories, protein, calcium, zinc and iron. Protein intake was of concern for the 42.4% of the sample who did not meet the than EAR (), but the mean intake (1.2 g/kg) was higher than the recommended 1.05 g/kg. Dietary intake should be individually assessed to better meet the needs of each person. The average caloric intake for the mother's was 2052.01 calories per day. Overall, the mean dietary intake for most nutrients was met, providing that the mothers had a generally well-balanced diet.

*Stress*

Overall, the women in the study had a typical level of stress when looking at the percentiles from the PSI results. The normal levels of stress could be due to the hormonal state that the mother's are experiencing during lactation. The current literature states that breastfeeding women have a lower level of stress, when compared to women who chose not to breastfeed their child, which is similar to the findings in our study (Mezzacappa, Guethlein, & Bagiella, 2000; Mezzacappa, Guethlein, & Katkin, 2002; Mezzacappa & Katkin, 2002).

An interesting finding was PCDI and DC were the two subscales of stress that significantly affected the dietary intake of the breastfeeding mothers, but in opposite ways. If the mother feels like her child is very difficult, as measured by the DC scale, then this was related to an increase in the mother's stress, which is related to an increase in caloric intake. This was shown in both the bivariate correlation analysis and the regression analysis. However the regression analysis uncovered further relations between intake and the PD and PC_DI subscales. In the regression analysis, the relation between PC_DI and intake was negative, suggesting that the relation between the amounts of care an infant requires and the ability of the infant to provide feedback is critical understanding the relation between parenting stress and intake.

To our knowledge, there is no current literature on the relation between stress and dietary intake in breastfeeding women.

## Section 3: Implications

### *Supplementation*

It is important for breastfeeding mothers to continue to take supplements after pregnancy and during lactation. Although our mothers had an relatively well-rounded diet, once supplementation was factored in their diet was better. The supplementation provided an increase in essential vitamins and minerals that were slightly low when compared to the EAR, specifically vitamin D, vitamin E, thiamin and vitamin C. I would recommend that all breastfeeding mothers consume some type of supplementation to ensure that they are getting enough of the essential vitamins and minerals to help feed their baby an adequate diet.

### *Calorie, Fat and Sugar Intake*

The amount of kilocalories that are consumed by the mother is important during lactation, especially when considering the quality of the babies diet. Although the average caloric intake for the mothers was good, there were 28 subjects (32.6%) that consumed less than 1700 calories per day. A woman needs to consume over 1700 kilocalories per day, or it could affect the quality and production levels of her milk, which in return, affects the dietary quality of the food that her infant is receiving (Mohammad, Sunehag, Haymond, 2009; Qian, Chen, Lu, Wu, Zhu, 2010). It is important for mothers to not limit their calorie intake too much, but they also do not want to consume too many kilocalories. I would recommend a mother consuming over 1,700 calories, but less than 2,500 kilocalories, depending on the mother’s individual measurements. Providing a range of calorie consumption for the mother might make the transition from pregnancy to lactation easier.

When a mother is consuming a diet that is high in fat, this makes the mother’s breast milk high in fat, which is providing a high fat diet to her infant. Breastfeeding mothers need to watch out for the amount of fat in their diet because it can be the difference between, for example, skim milk and whole milk for the baby. If the baby is consuming a high fat diet, then this may increase the chances of overweight and obesity in the infant.

The mothers in the study had a high amount of added sugar in their diet. This could be anything from soda pop consumption, adding sugar to their coffee or flavoring foods with added sugar. I would advise against a large amount of sugar being added to the diet because this increases their caloric intake significantly and is not providing any nutrients to their bodies or their infants. I think limiting the amount of pop that is being consumed and also limiting the amount of sugar to foods is a good idea in lactating women. Recommending a sugar substitute would be a good alternative for mother's who enjoy sweetening their foods.

*Stress*

Stress affected dietary intake in different ways, depending on the type of stress that was experienced. This shows that stress cannot be bundled up into one category. Also, different categories of people may be experiencing different types of stress and I think that is something we need to take into consideration. Just like nutritional recommendations are made for different groups of people, stress should be considered differently for each group of people. Further research needs to be done on the relation between stress and dietary intake.

**Section 4: Research Questions**

The hypothesis of this study was that the dietary intake of breastfeeding women will differ based on psychological and socioeconomic status. There were two specific aims of this study, including:

I. To describe the intake of breastfeeding women and compare it to the dietary intakes of kilocalories, protein, calcium, zinc and iron.

II. Examine the effect of stress, age, income, and marital status, on the dietary intakes of calories, protein, calcium, zinc and iron.

*Aim I*

The majority of the breastfeeding women (n=86) in the study met the intake of carbohydrates, but 42.4% of the women consumed less than the EAR values for protein. The intake of calcium, iron and zinc intake was adequate for the breastfeeding women, according to the EAR. When supplements were added to the dietary intake values of the breastfeeding mothers, this increased the total intake of calcium, zinc and iron. The intake of supplemental vitamins is important for breastfeeding women because it helps them to meet the needs of important vitamins and minerals that they are not consuming in their diet.

The vitamins that were low in the breastfeeding women's diet were vitamin E (90.7% less than the EAR), vitamin C (40.7% less than the EAR) and vitamin D (90.7% less than the EAR). Supplementation did increase the amount of vitamin E, vitamin C, and vitamin D in the total diet. Folate (68.6% less than the EAR), fiber (89.5% less than the AI), linoleic acid (51.2% less than the AI) and α-linolenic acid (51.2% less than the AI) intake was low for the women in the study, when comparing the mean intake to AI and EAR. Overall the women in the study had an adequate diet, only lacking a few vitamins and minerals when examining the mean intake of the women.

*Aim II*

Stress, age, income, and marital status all affected the dietary intake of zinc, calcium, iron and protein differently. Age, income and marital status did not affect the intake of zinc, calcium, iron and protein. PCDI and DC were significantly related to each of the nutrients but in different ways.. There is an opposite relation between these two stress variables and the dietary intake of the nutrient variables because the two stress variables are different and appear to have different effects on dietary intake. The stress factors associated with PCDI include the feeling that the mother's child does not do things that make the mother feel good, the child smiles less than expected, and/or the mother feels like her child doesn't like her or want to be close to her. The stress factors associated with DC include the child seeming to cry or fuss more than most children, having a very moody child, and/or her child gets upset easily over little things. Both of these factors are related to dietary intake. There is a relation between when a mother feels like she has a fussy, moody, difficult child and an increase in dietary intake. There is also a relation between a lower dietary intake and a mother feeling like her child does not do things that make her happy, or doesn't want to be close to her.

**Section 5: Limitations and Further Research**

One limitation of the study is the self-report for the surveys that are being conducted during the study (Vucic, Glibetic, Novakovic, Ngo, & Ristic-Medic, 2009). The women in the study complete all of the questionnaires and surveys on their own or with one other person present, but it is strictly from their point of view. Also, if there is any confusion that the mother might have while completing the Diet History Questionnaire (DHQ), there is no one to help the mother with the question she might have pertaining to the survey. The DHQ comes from a reliable and well-known source, the National Cancer Institute, and has been used for many years in various studies. The DHQ does not ask the mother to fill out questions in regards to supplemental use, but the questions are not specific and may not completely take into account the use of multi-vitamins versus individual vitamin and mineral supplementation.

Further research needs to be done on the relation between dietary intake and stress factors, specifically the types of foods that are being eaten during stressful events or situations. A 24-hour recall might be helpful in retrieving the specific types and amounts of foods that are being consumed. Blood levels of zinc and iron could be examined to better explain the actual intake of these nutrients, instead of relying on a intake survey. Having dietitians meet with women in their last trimester of pregnancy to discuss breastfeeding versus formula feeding and the diet that they consume, would be beneficial in this group of women.

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# APPENDIX 1
# DIETARY INTAKE

**Table 13: Dietary Intake (n=86)**

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| Food Energy-kcal | 2052.01 | 762.94 | 696.02 | 5359.26 |
| Protein-g | 82.19 | 29.03 | 26.80 | 159.62 |
| Total Fat-g | 76.38 | 30.72 | 25.48 | 152.62 |
| Saturated Fat-g | 27.09 | 12.55 | 8.47 | 72.35 |
| Monounsaturated Fat-g | 28.82 | 11.88 | 9.81 | 61.44 |
| Polyunsaturated Fat-g | 14.70 | 6.37 | 4.82 | 36.06 |
| Cholesterol-mg | 229.28 | 94.57 | 84.82 | 482.73 |
| Carbohydrate-g | 270.28 | 116.12 | 86.99 | 869.46 |
| Dietary Fiber-g | 19.72 | 7.81 | 4.58 | 44.13 |
| Alcohol-g | 0.55 | 1.08 | 0.00 | 5.8 |
| Vitamin A-IU (CSFII) | 9960.63 | 5537.36 | 1429.74 | 24778.74 |
| Vitamin A-mcg RE (CSFII) | 1408.20 | 653.20 | 213.90 | 3123.96 |
| Carotene-mcg RE (CSFII) | 790.39 | 530.31 | 69.39 | 2327.25 |
| Vitamin E-mg ATE (CSFII) | 9.68 | 4.79 | 2.79 | 30.12 |
| Vitamin C-mg | 150.21 | 151.50 | 27.20 | 1305.35 |
| Thiamin-mg | 1.68 | 0.65 | 0.55 | 4.32 |
| Riboflavin-mg | 2.31 | 0.94 | 0.58 | 6.73 |
| Niacin-mg | 21.98 | 8.02 | 8.15 | 44.02 |
| Vitamin B6-mg | 2.10 | 0.79 | 0.67 | 5.48 |
| Updated Folate-mcg (1998 CSFII) | 411.18 | 177.83 | 129.65 | 1349.38 |
| Vitamin B12-mcg | 5.16 | 2.24 | 1.06 | 15.54 |
| Calcium-mg | 1161.52 | 604.11 | 252.76 | 3785.32 |
| Phosphorus-mg | 1542.87 | 593.56 | 450.35 | 3714.20 |
| Magnesium-mg | 344.78 | 134.34 | 108.50 | 840.88 |
| Iron-mg | 16.56 | 6.12 | 5.29 | 36.18 |
| Zinc-mg | 13.13 | 5.42 | 3.98 | 32.88 |
| Copper-mg | 1.40 | 0.61 | 0.4 | 3.85 |
| Sodium-mg | 3190.72 | 1129.13 | 1033.59 | 6759.31 |
| Potassium-mg | 3366.88 | 1452.20 | 1071.21 | 11050.89 |
| Caffeine-mg | 102.51 | 144.70 | 0.80 | 622.82 |
| Theobromine-mg | 57.90 | 49.84 | 3.87 | 248.56 |
| Selenium-mcg | 95.94 | 32.81 | 31.68 | 189.37 |

**Dietary Intake Cont'd (n=86)**

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| Total Vitamin A Activity-mcg RAE(NDS-R) | 924.11 | 394.06 | 171.44 | 2545.10 |
| α-carotene (provitamin a cartenoid)-mcg (NDS-R) | 924.13 | 798.40 | 25.45 | 3531.27 |
| β-carotene (provitamin a cartoenoid)-mcg (NDS-R) | 3449.34 | 2121.75 | 297.02 | 8845.19 |
| β-cryptoxanthin (provitamin a carotenoid)-mcg (NDS-R) | 188.19 | 254.25 | 26.98 | 2247.58 |
| Lutein + Zeaxanthin -mcg (NDS-R) | 2510.35 | 1583.74 | 453.60 | 9598.58 |
| Lycopene -mcg (NDS-R) | 7178.64 | 4627.59 | 1135.79 | 24084.81 |
| β-carotene equivalents-mcg (NDS-R) | 4005.36 | 2532.79 | 334.58 | 10588.54 |
| Vitamin E-Total α-tocopherol-mg (NDS-R) | 8.90 | 4.12 | 2.55 | 24.96 |
| β-tocopherol-mg (NDS-R) | 0.35 | 0.15 | 0.08 | 0.88 |
| δ-tocopherol-mg (NDS-R) | 2.04 | 1.00 | 0.52 | 5.65 |
| γ-tocopherol-mg (NDS-R) | 13.15 | 5.63 | 3.67 | 26.22 |
| Vitamin D (calciferol)-mcg (NDS-R) | 5.78 | 3.64 | 0.75 | 21.74 |
| Methionine-g (NDS-R) | 1.78 | 0.63 | 0.54 | 3.42 |
| Folate-mcg (NDS-R) | 440.38 | 186.12 | 134.61 | 1323.42 |
| Dietary Folate Equivalents-mcg (NDS-R) | 560.66 | 229.15 | 171.84 | 1440.68 |
| Natural Folate (Food Folate)-mcg (NDS-R) | 268.68 | 147.47 | 81.46 | 1156.06 |
| Synthetic Folate (Folic Acid)-mcg (NDS-R) | 171.99 | 86.23 | 36.50 | 529.23 |
| Total Dietary Fiber-g (NDS-R) | 19.68 | 7.73 | 4.48 | 44.05 |
| Insoluble Dietary Fiber-g (NDS-R) | 13.05 | 5.24 | 2.96 | 29.52 |
| Soluble Dietary Fiber-g (NDS-R) | 6.45 | 2.57 | 1.41 | 14.23 |
| Total Trans-Fatty Acids (TRANS)-g (NDS-R) | 4.60 | 2.13 | 1.49 | 11.80 |
| 16:1 TRANS (trans-hexadecenoic acid)-g (NDS-R) | 0.06 | 0.04 | 0.01 | 0.19 |
| 18:1 TRANS (trans-octadecenoic acid [elaidic acid])-g (NDS-R) | 3.92 | 1.85 | 1.21 | 10.54 |
| 18:2 TRANS (trans-octadecadienoic acid [linolelaidic acid])-g (NDS-R) | 0.57 | 0.26 | 0.17 | 1.39 |
| Glycemic Load | 131.55 | 61.84 | 41.69 | 451.02 |

**Table 14: Dietary Intake of Fatty Acid (n=86)**

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| Fatty Acid 4:0-g | 0.71 | 0.51 | 0.10 | 3.09 |
| Fatty Acid 6:0-g | 0.37 | 0.29 | 0.05 | 1.74 |
| Fatty Acid 8:0-g | 0.29 | 0.17 | 0.05 | 1.14 |
| Fatty Acid 10:0-g | 0.57 | 0.39 | 0.11 | 2.44 |
| Fatty Acid 12:0-g | 0.95 | 0.48 | 0.21 | 3.16 |
| Fatty Acid 14:0-g | 2.74 | 1.67 | 0.59 | 10.18 |
| Fatty Acid 16:0-g | 14.25 | 6.17 | 4.68 | 33.56 |
| Fatty Acid 16:1-g (CSFII) | 1.34 | 0.62 | 0.49 | 3.52 |
| Fatty Acid 18:0-g | 6.28 | 2.76 | 2.04 | 14.93 |
| Fatty Acid 18:1-g (CSFII) | 26.84 | 11.06 | 9.06 | 57.31 |
| Fatty Acid 18:2-g (CSFII) | 13.14 | 5.87 | 4.20 | 34.42 |
| Fatty Acid 18:3-g | 1.31 | 0.53 | 0.44 | 2.65 |
| Fatty Acid 18:4-g | 0.00 | 0.00 | 0.00 | 0.02 |
| Fatty Acid 20:1-g | 0.15 | 0.11 | 0.03 | 0.80 |
| Fatty Acid 20:4-g | 0.10 | 0.05 | 0.02 | 0.29 |
| Fatty Acid 20:5-g | 0.02 | 0.02 | 0.00 | 0.07 |
| Fatty Acid 22:1-g | 0.01 | 0.01 | 0.00 | 0.06 |
| Fatty Acid 22:5-g | 0.01 | 0.01 | 0.00 | 0.03 |
| Fatty Acid 22:6-G | 0.04 | 0.03 | 0.00 | 0.13 |

**Table 15: Percentage of Energy From (n=86)**

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| Protein-g | 16.22 | 2.65 | 10.66 | 22.76 |
| Total Fat-g | 33.39 | 5.81 | 19.89 | 44.39 |
| Saturated Fat-g | 11.78 | 2.94 | 6.06 | 22.23 |
| Monounsaturated Fat-g | 12.59 | 2.44 | 7.28 | 19.50 |
| Polyunsaturated Fat-g | 6.47 | 1.79 | 3.38 | 12.86 |
| Carbohydrates-g | 52.58 | 6.84 | 39.24 | 67.17 |
| Alcohol-g | 0.22 | 0.56 | 0.00 | 4.01 |

**Table 16: Supplemental Vitamin and Mineral Intake (n=86)**

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| Vitamin A (IU) | 2231.24 | 1570.34 | 0.00 | 3571.43 |
| Vitamin A (mcg RAE) | 669.37 | 471.10 | 0.00 | 1071.43 |
| β-carotene | 267.75 | 188.44 | 0.00 | 428.57 |
| Vitamin E | 9.59 | 7.34 | 0.00 | 45.80 |
| Vitamin C | 34.78 | 45.10 | 0.00 | 400.00 |
| Thiamin | 0.89 | 1.28 | 0.00 | 7.50 |
| Riboflavin | 0.91 | 0.96 | 0.00 | 5.50 |
| Niacin | 9.67 | 7.48 | 0.00 | 35.71 |
| Vitamin B6 | 3.40 | 8.75 | 0.00 | 44.29 |
| Folic Acid | 190.46 | 138.40 | 0.00 | 457.14 |
| Vitamin B12 | 2.68 | 1.89 | 0.00 | 4.29 |
| Calcium | 77.05 | 185.75 | 0.00 | 714.29 |
| Magnesium | 41.47 | 32.59 | 0.00 | 71.43 |
| Iron | 10.21 | 9.56 | 0.00 | 34.29 |
| Zinc | 6.22 | 4.89 | 0.00 | 10.71 |
| Copper | 0.83 | 0.65 | 0.00 | 1.43 |
| Vitamin D | 178.50 | 125.62 | 0.00 | 285.71 |
| Selenium | 0.00 | 0.00 | 0.00 | 0.00 |

APPENDIX II

CORRELATIONS TABLE 1

| | | Age | Employment | Household Income Level | Marital Status |
|---|---|---|---|---|---|
| PSI_PD | Pearson Correlation | .020 | -.114 | -.030 | -.187 |
| | Sig. (2-tailed) | .855 | .295 | .786 | .085 |
| | N | 86 | 86 | 86 | 86 |
| PSI_PCDI | Pearson Correlation | .164 | .040 | -.016 | -.008 |
| | Sig. (2-tailed) | .130 | .713 | .887 | .944 |
| | N | 86 | 86 | 86 | 86 |
| PSI_DC | Pearson Correlation | .082 | .106 | -.089 | -.039 |
| | Sig. (2-tailed) | .452 | .332 | .416 | .722 |
| | N | 86 | 86 | 86 | 86 |
| PSI_TotalStress | Pearson Correlation | .149 | -.014 | -.039 | -.061 |
| | Sig. (2-tailed) | .174 | .897 | .722 | .582 |
| | N | 85 | 85 | 85 | 85 |

# APPENDIX III

## CORRELATIONS TABLE 2

**Correlations**

| | | Calcium - mg | Prog_kg | kcal_3wt | Zinc - mg | Iron - mg |
|---|---|---|---|---|---|---|
| PSI_PD | Pearson Correlation | .186 | .174 | .186 | .164 | .098 |
| | Sig. (2-tailed) | .086 | .109 | .086 | .131 | .367 |
| | N | 86 | 86 | 86 | 86 | 86 |
| PSI_PCDI | Pearson Correlation | -.121 | -.002 | .036 | -.080 | -.116 |
| | Sig. (2-tailed) | .265 | .986 | .740 | .466 | .289 |
| | N | 86 | 86 | 86 | 86 | 86 |
| PSI_DC | Pearson Correlation | .203 | .186 | .225* | .210 | .160 |
| | Sig. (2-tailed) | .061 | .086 | .037 | .052 | .142 |
| | N | 86 | 86 | 86 | 86 | 86 |
| PSI_TotalStress | Pearson Correlation | .163 | .185 | .211 | .157 | .067 |
| | Sig. (2-tailed) | .137 | .090 | .052 | .150 | .543 |
| | N | 85 | 85 | 85 | 85 | 85 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

APPENDIX IV

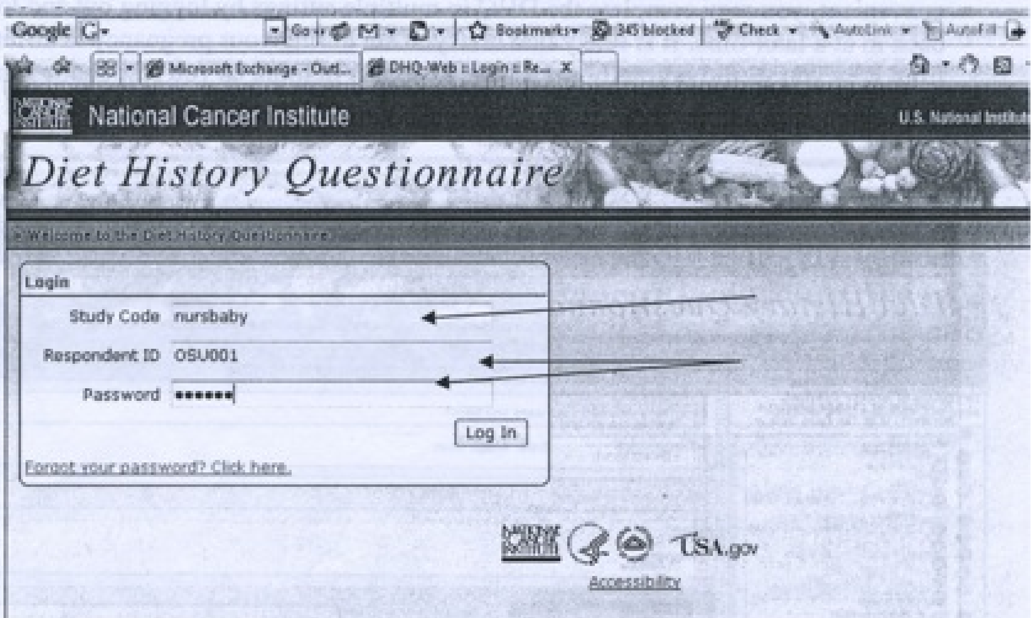
DIET HISTORY QUESTIONNAIRE

# *Directions for completing the*
# *Diet History Questionnaire*

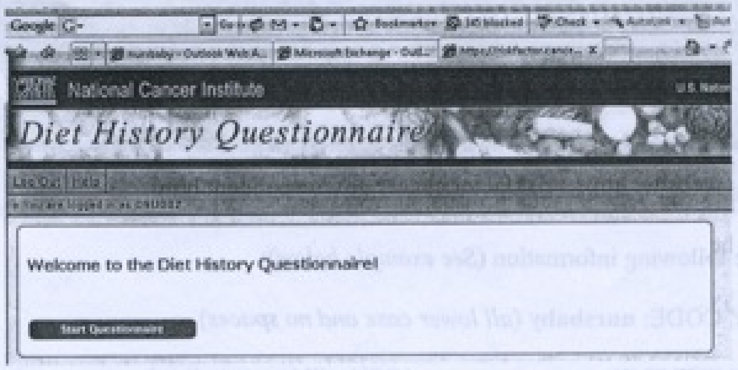
- ☐ Log on to the website: https://riskfactor.cancer.gov/respondent.html.

- ☐ Log in with the following information (*See example below*):

  - STUDY CODE: **nursbaby** (*all lower case and no spaces*)
  - RESPONDENT ID: ____________ (*OSU will be capitalized – no spaces*)
  - PASSWORD: Will be the same as your Respondent ID
  - Remember to answer questions over the past 12 months. Therefore, you will be answering basically from the time that you became pregnant to now that your baby is 3 months of age.



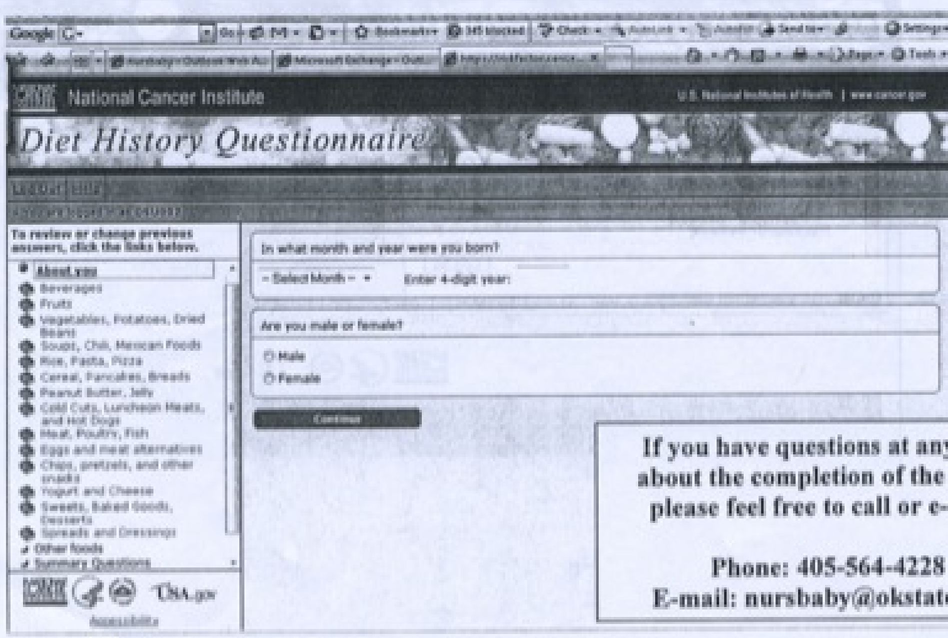
☐ Once you are successfully logged on you will see the following screen:




☐ Select "Start Questionnaire"

☐ You will be given directions on completing the DHQ before you begin. At the bottom of this direction screen, you will again need to select "Start Questionnaire"

☐ What will follow will be a series of questions about your diet over the past 12 months. Answer each question as accurately and honestly as possible. If it is more convenient, you may complete the DHQ in multiple sittings by logging out and logging back in at a later time. It is likely that how you ate during your pregnancy is different from how you would normally eat. Please keep this in mind as you respond to this questionnaire and try to answer all items candidly.




**If you have questions at any time about the completion of the DHQ, please feel free to call or e-mail.**

**Phone: 405-564-4228**
**E-mail: nursbaby@okstate.edu**

APPENDIX V

DEMOGRAPHICS FORM

**Demographic Information Questionnaire**

**Child Information**

What is your relationship to the baby? Example: mother, father, stepmother.

______________________________________________

Gender of baby _____ Male _____ Female

Birthdate of baby ______________
Month Day Year

Birth weight of baby ___lbs ___oz

Date of expected birth (due date) ______________
Month Day Year

Was the baby born by c-section? YES NO

**Maternal Information**

Birthdate ______________
Month Day Year

Your marital status (check one)

___ Married, first time
___ Single, separated
___ Single, widowed
___ Other, please specify: ______________
___ Single, never married
___ Single, divorced
___ Remarried

Your own ethnic group (please check)

___ Native American Nation: ______________
___ African American
___ Hispanic
___ Asian
___ White
___ Multiethnic Describe: ______________
___ _Other Describe: ______________

Please place a check mark next to the highest grade you completed in school.

____ 6th grade
____ 7th grade
____ 8th grade
____ 9th grade
____ 10th grade
____ 11th grade
____ 12th grade
____ some vo-tech
____ some college courses
____ vo-tech graduate
____ college graduate

Please place a check mark next to the highest grade your spouse/partner completed in school.

____ 6th grade
____ 7th grade
____ 8th grade
____ 9th grade
____ 10th grade
____ 11th grade
____ 12th grade
____ some vo-tech
____ some college courses
____ vo-tech graduate
____ college graduate

Your current household income per month before taxes (please check one)

___ $ 0 - 100
___ $ 100 - 499
___ $ 500 - 999
___ $ 1000 - 1499
___ $ 1500 - 1999
___ $ 2000 - 2499
___ $ 2500 - 2999
___ $ 3000 - 3499
___ $ 3500 - 3999
___ $ 4000 plus

Is your current spouse/partner the father of the baby (check one)

___ yes ___ no

Ethnic group of the biological father of the baby. (please check)

___ Native American Nation: ____________
___ African American
___ Hispanic
___ Asian
___ White
___ Multiethnic Describe: ____________
___ Other Describe: ____________

Do you currently receive state or federal financial assistance? (check as many as apply)

___ WIC
___ TANF
___ School lunch/breakfast
___ Food Stamps
___ Indian Health Services
___ Unemployment benefits
___ Energy assistance
___ Social Security/SSI
___ Medicaid

For how many years have you received such assistance? (check one)

___ five or more years
___ four years
___ three years
___ two years
___ one year
___ less than one year

My child seems to be less healthy than other children I know.

____ strongly agree
____ agree
____ do not agree or disagree
____ disagree
____ strongly disagree

My child has never been seriously ill.

____ agree
____ disagree

Where did you hear about our study? Were you referred by a friend or did you see a poster, newspaper ad, poster, etc? ________________________________________________

VITA

Megan Dawn Gilchrist

Candidate for the Degree of

Master of Science

Thesis: RELATIONS BETWEEN DIETS OF BREASTFEEDING WOMEN, SOCIOECONOMIC STATUS AND STRESS

Major Field: Nutritional Sciences

Biographical:

Education: Graduated from Owasso High School, in Owasso, OK, May 2005; received a Bachelor of Science Degree in Nutritional Sciences, with a Dietetics Option at Oklahoma State University, Stillwater, OK, in August 2009. Completed the requirements for the Master of Science degree with a major in Nutritional Sciences at Oklahoma State University, Stillwater, OK, in 2010.

Experience: Employed by Oklahoma State University, College of Human Environmental Sciences as a teaching assistant for NSCI 3813, Assessment and Counseling, Spring 2010. Employed by Oklahoma State University, College of Human Environmental Sciences, as a teaching assistant for HRAD 1114, Introduction to Professional Food Preparation, Fall 2010. Employed by Oklahoma State University as a teaching assistant for HRAD

Professional Memberships: American Dietetic Association, Oklahoma Dietetic Association.

Name: Megan Dawn Gilchrist Date of Degree: May 2011

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: RELATIONS BETWEEN DIETS OF BREASTFEEDING WOMEN, SOCIOECONOMIC STATUS AND STRESS

Pages in Study: 80 Candidate for the Degree of Master of Science

Major Field: Nutritional Sciences

The objective of this study was to describe the relation between parenting stress and the dietary intakes of 84 women breastfeeding 3-month-old infants. The design is cross-sectional and participants are located in a rural Oklahoma community; surveys include the NCI Diet History Questionnaire (DHQ) assessing kilocalories, protein, calcium, zinc and iron and the Parenting Stress Index-Short Form (PSI) containing four different subscales, Difficult Child (DC), Parental Distress (PD), Parent-Child Dysfunctional Interaction (PCDI) and Defensive Responding (DR). Regression analysis showed no relation between diet, total stress and income. PCDI was negatively correlated to the nutrients of interest (kilocalories, protein, Ca, Zn, Fe) and DC was positively correlated to the nutrients of interest (kilocalories, protein, Ca, Zn, Fe). When PCDI stress is greater than DC stress, there is a decrease in dietary intake. When DC stress is greater than PCDI stress, there is an increase in dietary intake. Overall, dietary intake was not related to socioeconomic status factors, but was related to stress. Specifically, PCDI stress was negatively correlated to dietary intake and DC stress was positively correlated to dietary intake. This project was supported by National Research Initiative Grant 2008- 35200-18779 from the USDA National Institute for Food and Agriculture.

ADVISER'S APPROVAL: Dr. Tay Kennedy